SPECTRUM OF MRI FINDINGS IN ROTATOR CUFF PATHOLOGIES AND GLENOHUMERAL INSTABILITY

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Dedicated

to

my Family

&

Teachers

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Dr. Arpit Jindal

ABBREVIATIONS

MR	Magentic Resonance
USG	Ultrasonography
AC	Acromio Clavicular
MRI	Magnetic Resonance Imaging
CT	Compueted Tomography
US	Ultrasound
MRA	Magnetic Resonance Arthrography
MEDIC	Multiple Echo Data Image Combination
PD	Proton Density
RCT	Rotator Cuff Tear
GH	Glenohumeral
SLAP	superior labrum anterior and posterior
PRCTC	Partial thickness rotator cuff tears
ALPSA	Anterior labroligamentous periosteal sleeve avulsion
HAGL	Humeral avulsion of the glenohumeral ligament
GLAD	Glenoid Labral Articular Defect
POLSPA	Posterior Labracapsular Periosteal Sleeve Avulsion
FTT	Full thickness tears
PTT	Partial thickness tears
MGHL	Middle Gleno Humeral Ligament

ABSTRACT

INTRODUCTION: Shoulder pain can be due to variety of causes. Acute fractures can be evaluated using routine radiographs but patients with protracted pain and atypical presentations and suspected soft tissue pathology like rotator cuff tears and glenohumeral instability, need imaging evaluation with magnetic resonance imaging (MRI)

OBJECTIVES: To study the spectrum of MRI findings in Rotator cuff pathologies and glenohumeral instability and to correlate MRI findings with arthroscopic findings wherever possible.

MATERIALS AND METHODS: Hospital based prospective study was carried out on 70 patients who were clinically suspected of rotator cuff pathologies and glenohumeral instability/ dislocation. All patients underwent MRI of shoulder joint. Anatomical variants as well as status of rotator cuff tendons, labrum, ligaments and bony changes were recorded and analyzed. Computed tomography sections were taken wherever required

RESULTS: Rotator cuff tears(57%) are more common than labral tears(40%). Tear of supraspinatous tendon was the most common(47%). SLAP tear was seen in 8.6% of patients. Labral variants were seen in 21.4% of patients. Type 2 was the most common type of acromion in 81.4% of patients with spur seen in 31.4% patients.8 patients were operated and MRI findings were confirmed intra-operatively.

Conclusion: The unique ability of MRI to precisely localize and acquire images in three planes makes it the investigation of choice in shoulder joint pathologies. The detailed pre operative non-invasive evaluation of rotator cuff and labral pathologies are important for clinician for patient management.

Keywords: Rotator cuff tear, glenohumeral Instability, 3.0T Magnetic resonance imaging, MR arthroscopy.

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INTRODUCTION

The shoulder joint is functionally and structurally complex joint and is composed of bone, hyaline cartilage, labrum, ligaments, capsule, tendons and muscles. It joins the trunk to the upper limb and plays an important biomechanical role in daily activities.

Shoulder joint is the most flexible joint in the entire human body is. This is due to the action of four separate articulations: the glenohumeral, acromioclavicular, sternoclavicular, and scapulothoracic joints.

MODALITIES

Various modalities are used to evaluate pathologies of shoulder joint. These include routine radiography, ultrasound, CT and MR imaging (conventional and arthrography).

Conventional radiography of the shoulder is used as the first-line imaging procedure for assessment of bone pathology, i.e fractures, dislocations, bone tumors and infection and also for evaluation of abnormalities of joints and fat pads. However it has its limitations, these include limited soft tissue evaluation, ionizing radiation and difficulties of patient positioning (due to pain, fracture, ankylosis etc.). Two orthogonal views (anteroposterior and lateral views) of any bone or joint are ideally obtained. In daily practice, the anteroposterior view is performed in neutral position and a Y view is used for scapula.

USG is used to evaluate shoulder joint because of its easy accessibility. The clinical indications for shoulder USG include rotator cuff disorders, bursitis and shoulder impingement. Ultrasonographic evaluation of the shoulder is limited to the long head of biceps tendon, the rotator cuff, the subacromial-subdeltoid bursa and AC joint. An advantage of US is the dynamic evaluation of shoulder impingement (i.e. in internal & external rotation).[1]

Computed Tomography is a good modality for evaluation of shoulder joint. Pathologies that are poorly visualized on conventional radiographs are better evaluated on CT. It provides multiplanar reconstructions, surface rendering of the osseous structures with rotation of the reconstructions. Complex fractures and dislocations,

bony fragments and calcifications are better assessed on CT. In bone tumors or some soft tissue tumors, the matrix calcification (osteoid or cartilaginous) could be described precisely.

Conventional MRI allows direct evaluation of rotator cuff muscles and tendons, medullary bone and the neurovascular structures. The major disadvantages are longer examination time and higher cost, respiratory motion artefacts and patient claustrophobia. MR images are obtained with a dedicated shoulder coil at 1.5 or 3 Tesla.

MR Arthrography was used quite often in past for an detection of capsulolabral lesions thanks to the distension of the joint capsule. Direct MRA uses intra-articular injection of gadolinium based contrast. Indirect MRA is performed after intravenous contrast injection is less invasive and expensive but lacks capsular distension and is therefore less accurate than direct MRA. The unique ability of MRI to precisely localize and acquire images in all three planes makes it the investigation of choice in shoulder joint pathologies. MRI is noninvasive, which combines the soft-tissue contrast with tomographic possibilities, without using ionizing radiation

TECHNIQUE OF SHOULDER JOINT MRI

MRI of the shoulder joint gives excellent information of both soft tissue and osseous structures. A knowledge of the imaging techniques, normal anatomy and its variants and diagnostic pitfalls help in better diagnostic accuracy on shoulder MRI studies.

Positioning of the patient

The patient lies in a supine position with arm placed along the side of his/her body. Neutral position with mild external rotation is preferred. This position helps in better evaluation of labrum.[2,3] Internal rotation is avoided as it results in overlap of the supraspinatus and infraspinatus muscle.

Coils

The surface coil is essential for imaging of the shoulder. It helps in producing images with high signal to noise ratio and allows for improved spatial resolution. The commonly used surface coil is the single loop coil which is a linear coil in curved fashion. Coils can be rigid or flexible. In shoulder, surface coil is to be placed in a coronal oblique plane to increase the signal to noise ratio and coil is centered over area of primary interest.[4] Restraint bands may be used to restrict movement of the coil with movement of the patient.

A scout image is obtained in all planes. A small field of view of 14cms and slice thickness of 2 to 3mm are used and images are acquired in transaxial plane, coronal oblique plane and sagittal oblique plane.

Transaxial plane: This plane extends from acromioclavicular joint to inferior glenoid fossa. Proton density sequences and T1 weighted fast spin echo sequences are applied in transaxial plane. These sequences provide better evaluation of long head of biceps tendon, labrum, glenohumeral ligaments, subscapularis and infraspinatus muscles/tendons. MEDIC sequences are also taken in axial planes

Coronal oblique plane: The images are obtained parallel to supraspinatus tendon. Proton density, T2 weighted fast spin echo with and without fat saturation are acquired in this plane to look for potential tears or other abnormalities of rotator cuff muscles and tendons. It is used for assessing the amount of retraction in case of full thickness rotator cuff tears. It is also used to assess the superior and inferior aspect of labrum.[5]

Sagittal oblique plane: The images are obtained perpendicular to the long axis of supraspinatus tendon extending from glenoid fossa to the lateral cortex of humerus. T1 and PD fat sat sequences in sagittal oblique plane are obtained to evaluate and confirm the rotator cuff and labral pathologies, determine their extent and abnormalities of adjacent structure.

OSSEOUS ANATOMY

ACROMION ANATOMY

The acromion is a posterolateral extension of the scapular spine. Acromion articulates with the clavicle and is the origin of the deltoid and trapezius muscles.[6]

Variation in the shape of the acromion can cause a variety of pathologies such a impingement syndrome and rotator cuff tear (RCT).[7]

The pathogenesis of RCT can be related to the morphology of the acromion which is usually assessed by parameters like the acromial type, acromial slope, acromial tilt, lateral acromial angle.[8]

The magnetic resonance imaging helps to depict all the above mentioned parameters. These factors are suggested to influence the status of the rotator cuff.[9,10]

The acromial shape can be classified into four types: type I (flat), type II (curved), type III (hooked), and type IV (convex). Acromion shape and other associated variants can be best evaluated using MRI slices in two planes.[11]

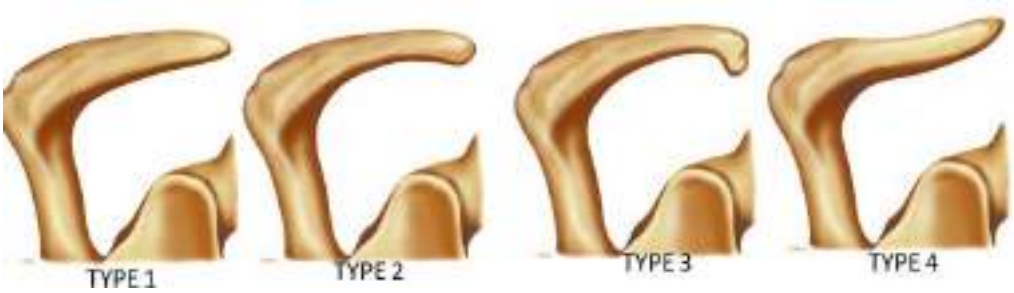

Figure 1: Types of acromion [12]

Os acromiale, it is one of the rare causes of rotator cuff tears and impingement syndrome. Os acromiale can also decrease the volume of sub-acromial space. Os acromiale is commonly unilateral and is more frequent in type III acromial shape. Detection of the os acromiale on MR is best seen on axial plane that includes the acromion.[13]

The shape and slope of the acromion is best evaluated on sagittal oblique sections. On coronal images the relative location of the acromion to the distal clavicle can be evaluated. An inferior location of acromion relative to that of the clavicle is described as ‘low lying acromion’.

Proximal Humerus

The proximal humerus is made of the humeral head, the greater and lesser tuberosities, the humeral neck, and bicipital groove. The greater tuberosity is located on the lateral aspect of the humerus and is the site of insertion of rotator cuff tendons i.e. the supraspinatus, infraspinatus, and teres minor tendons. The lesser tuberosity is situated on the anterior aspect of the proximal humerus, medial to the greater tuberosity. Subscapularis tendon inserts here.

The groove between the two tuberosities of the humerus is known as the intertubercular or bicipital groove and this groove supports the long head of the biceps tendon. The width and depth of the groove both affect the risk of subluxation of the long head of the biceps tendon.[14,15]

A deep notch or physiological flattening in the humeral head is located posterior to the greater tubercle and best visualized on axial images. This should not be mistaken for a Hill-Sachs lesion which is seen at or above the level of the coracoid process.

Cartilage

The assessment of humeral cartilage remains critical due to the small cartilage thickness at this level (approximately 1mm). The articular cartilage of the humeral head is thicker centrally and thinner peripherally contrary to the glenoid articular cartilage which is relatively thinner centrally and thicker peripherally. Recognition of normal thinning of peripheral humeral cartilage is essential in order to not mistaken it with posttraumatic or degenerative sequels. A normal bare area is seen in the posterolateral aspect of the humeral head, and should not be considered as cartilage defect on axial sections. True cartilage defects are often located in the posterosuperior portion medial to the location of the bare area.[16,17]

Scapula

The scapula consists of the scapular body, the scapular spine, the scapular neck, the acromion, the glenoid fossa and coracoid process. The dorsal aspect of the scapula is divided by the scapular spine into supraspinous and infraspinous fossa where the supraspinatus and infraspinatus muscles attach respectively.

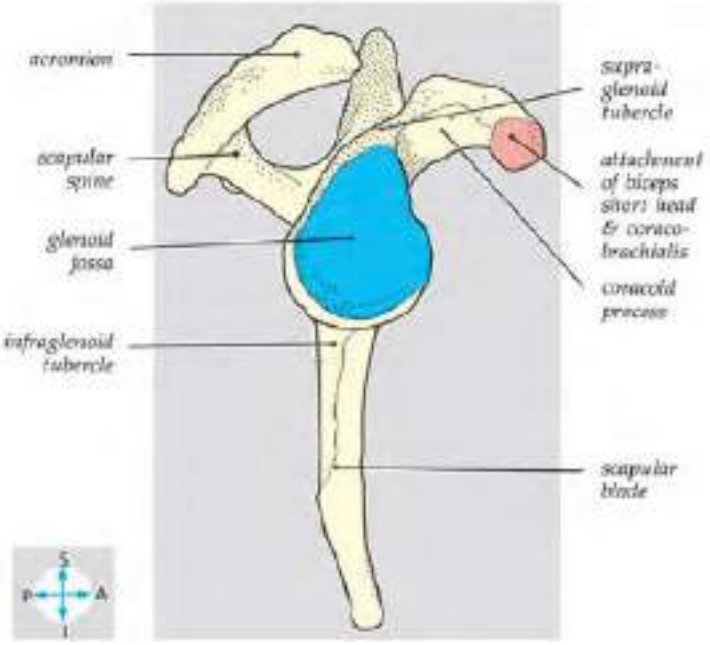

Figure 2 : Parts of Scapula [12]

Glenoid

The glenoid cavity forms a glenohumeral joint with the medial aspect of the humeral head. The glenoid is pear or oval shaped on sagittal images. The glenoid cavity is retroverted, approximately 5° to 7°.[18] At the superior aspect of the glenoid, the long head of the biceps attaches to the supraglenoid tubercle.

Coracoid Process

The coracoid process is a hook-shaped bony structure projecting anterolaterally from the superior aspect of the scapular neck. It represents the tendinous origin of a number of upper extremity and chest wall muscles. The coracoid overlap and retroversion angle have a clinical impact on the subcoracoid space and leads to subcoracoid impingement of the subscapularis tendon between the lesser tuberosity and the coracoid process.[19]

Soft Tissue Structures

To move and support the shoulder, different structures work in synergy like muscles, tendons, ligaments, and cartilaginous structures. Precise knowledge of the normal anatomy and variants is important to recognize the pathologies.

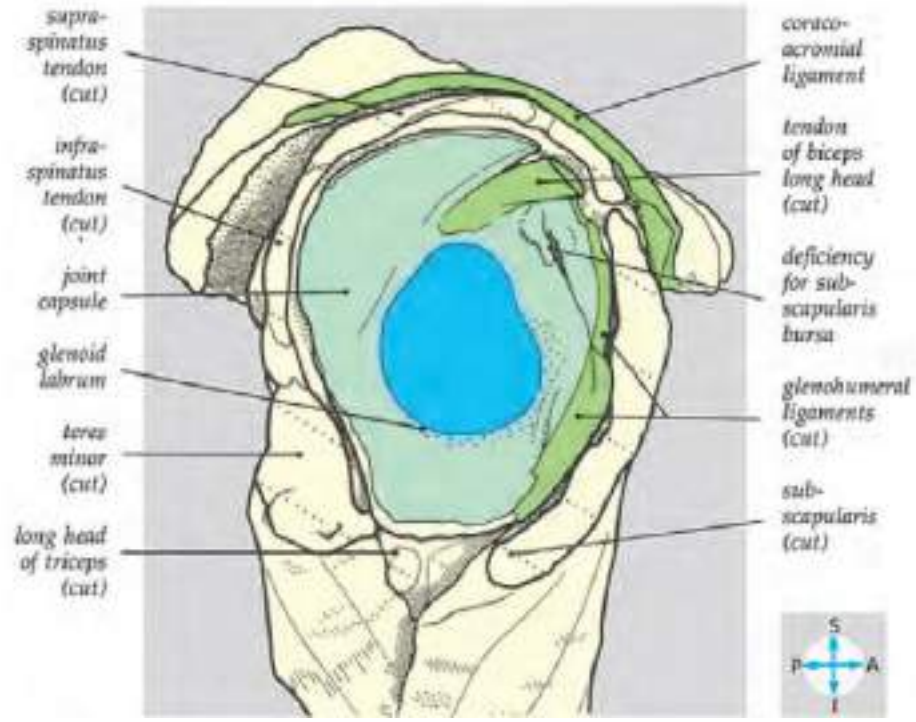

Figure 3: Glenoid Labrum [12]

Normal Labrum

The glenoid labrum is a fibrocartilaginous structure which is attached around the margin of the glenoid cavity and covering the bony surface. It provides stability to the glenohumeral joint, restricting anterior and posterior displacement of the humeral head. The labrum is larger superiorly. The superior portion of the labrum is closely associated with the biceps tendon.

The labrum is marked 1 to 12’0 clock from anterior to posterior in a sagittal image.

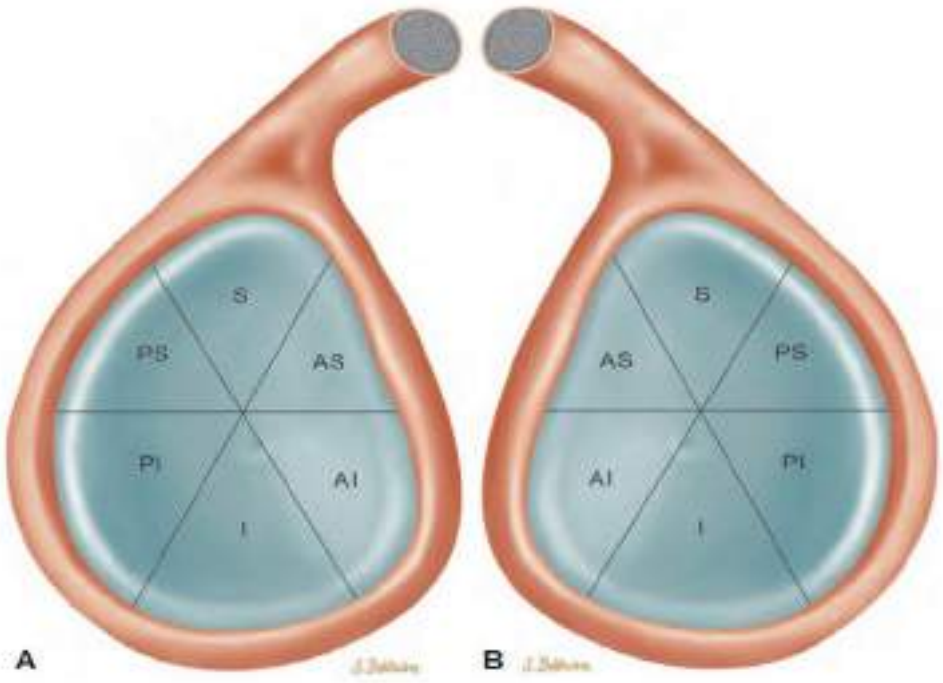

Figure 4: Quadrants of labrum [12]

Labral Variants

Sublabral Recess

It is also known as ‘sublabral sulcus’, this is a physiological recess and is the most common variant. It represents variation of the configuration of the biceps labral complex at the 11 and 1 o’clock positions. Sublabral recess has smooth margins and measures less than 2 mm in width. The recess follows the surface of the glenoid rim, and does not extend posterior to the biceps anchor. It should not be mistaken with a type II SLAP lesion or a SLAP tear which extends laterally or posteriorly.[20]

Sublabral Foramen

It is also known as ‘sublabral hole’. This foramen is less common and represents a normal detachment of the anterosuperior labrum from the glenoid rim at the one and three o’clock positions anterior to the attachment of the biceps labral complex. It has smooth edges and measures less than 1.5 mm in width. It is oriented medially and posteriorly towards glenoid. The sublabral foramen provides a communication between the glenohumeral joint and the subscapularis

recess.[17] The sublabral foramen is sometimes confused with an anterosuperior labral tear in patients with clinical symptoms. A true tear typically travels for a greater distance superiorly into the bicipital anchor or inferiorly into the inferior glenohumeral ligament attachment site.[17] The sublabral recess may coexist and communicate with the sublabral foramen.[1,14]

Buford Complex

The Buford complex is a combination of two variants which are a significant thickening of the middle glenohumeral ligament with a cord-like appearance and associated congenital absence of the anterosuperior labrum. This variant is uncommon and can be encountered in 1.5–2% of individuals.[21] The thickened middle glenohumeral ligament attaches directly on anterosuperior glenoid and may be sometimes mistaken for a displaced labral fragment.[22]

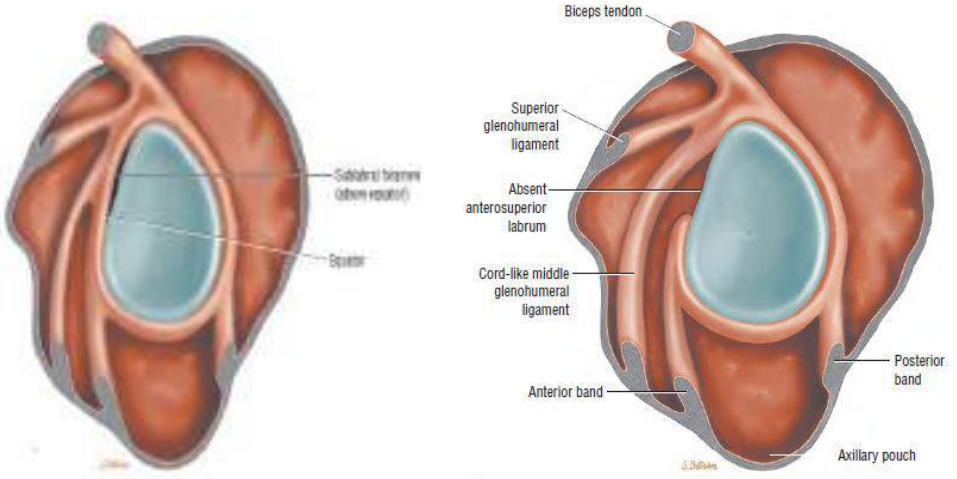

Figure 5: Labral variants [12]

Ligaments

Glenohumeral Ligaments

The glenohumeral ligaments are fibrous reinforcements of the glenohumeral capsule and they represent the most important passive stabilizers of the shoulder joint. Three ligaments are recognized: the superior glenohumeral ligament, the middle glenohumeral ligament and the inferior glenohumeral ligament. They can easily be identified when an articular effusion is present.[20,22] The inferior glenohumeral ligament

consists of an anterior and posterior band as well as the axillary pouch .The superior capsule contains the superior glenohumeral ligament, the coracohumeral ligament, the rotator cable and also the posterosuperior glenohumeral ligament as described by Pouliart et al.[23]

Superior Glenohumeral Ligament Complex

The superior glenohumeral ligament consists of two proximal attachments, one on the anterosuperior aspect of the labrum conjoined with the biceps tendon, and the other on the base of the coracoid process.[18] This ligament runs horizontally, almost parallel to the long head of the biceps tendon, in the direction of the coracoid process. It courses between the anterosuperior glenoid rim and the humeral head, just above the greater tuberosity. It can be absent in 10% of healthy subjects.[14] Variant origins of the superior glenohumeral ligament includes common origin with the middle glenohumeral ligament and/or direct origin from the biceps tendon. .[16,23]

Middle Glenohumeral Ligament

The middle glenohumeral ligament originates from the anterosuperior labrum or mid-anterior labrum, just below the superior glenohumeral ligament and runs obliquely to attach to the anatomical neck of humerus, adjacent to the lesser tuberosity. It may have a conjoined attachment together with the superior glenohumeral ligament, or together with the long head of the biceps tendon when the superior glenohumeral ligament is absent at the 12 and 1 o'clock positions. The middle part of the ligament lies posterior to the subscapularis; where it may blend together with fibers of the subscapularis muscle. It can vary in size and shape but is usually thin.[14,15] It may appear thickened and cordlike, as in the Buford complex, or completely absent in 30% of subjects. In this case the capsular recess is prominent anteriorly and beneath the subscapularis tendon.[14,15] Variant appearances of the middle glenohumeral ligament include absence of the middle glenohumeral ligament, a conjoint origin with either the superior glenohumeral ligament or inferior glenohumeral ligament, Buford complex.[17] The middle glenohumeral ligament is best visualized on sagittal oblique and axial MR images.[15]

Inferior Glenohumeral Ligament

The inferior glenohumeral ligament is actually a complex of anterior band, posterior bands and an axillary pouch. The axillary pouch has a U-shaped appearance when the inferior glenohumeral ligament is normal.[1,23,24] Its origin is inseparable from the base of the labrum. The anterior band arises from the inferior glenoid rim at the 2 o'clock to 4 o'clock positions. The posterior band arises from the inferior glenoid rim at the 7 o'clock to 9 o'clock position. Both the anterior band and posterior band insert along the inferior aspect of the surgical neck of the humerus.[16,22] It is the most important glenohumeral ligament in terms of stability.

ROTATOR CUFF MUSCLES

The rotator cuff allows the range of motion of the shoulder joint and protects and stabilizes the glenohumeral joint. It is made up of the muscles and tendons of the supraspinatus, infraspinatus, subscapularis and teres minor.

The supraspinatus arises from the posterior aspect of the scapula, above the scapular spine, and courses horizontally and anteriorly. The acromioclavicular joint, forms a landmark for its musculotendinous junction. The subacromial-subdeltoid bursa, which usually contains minimal fluid, drapes over the supraspinatus muscle and tendon and lies just beneath the acromion. Recent anatomic and orthopedic literature suggests that it has a relatively small triangular footprint on the superior facet of the greater tuberosity.[25,26]

Importantly, the larger anterior portion of the supraspinatus muscle pulls a smaller area of anterior tendon, predisposing the anterior articular fibers to more strain and subsequent tear propagation.[27-30]

The infraspinatus muscle arises from posterior aspect of the scapula, below the scapular spine. It then courses laterally, and the anterior border of the infraspinatus tendon insertion overlaps the posterior border of the supraspinatus tendon, to attach to the greater tuberosity.

The teres minor muscle, arises from the middle portion of the lateral scapular border and the dense fascia of infraspinatus to insert on the inferior facet of the greater tuberosity.

The subscapularis muscle arises from the anterior surface of the scapula and courses laterally under the coracoids. Its musculo-tendinous junction lies at the level of the glenoid. This muscle attatches to the lesser tuberosity in a comma shape, with a broad proximal and tapering distal footprint.[31,32]

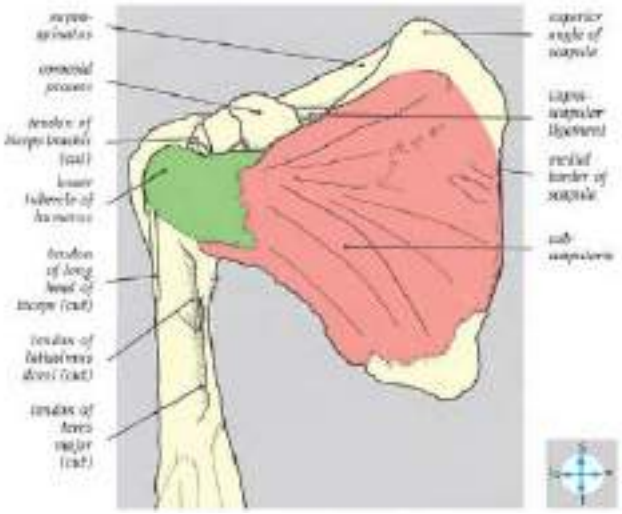

Figure 6: Rotator Cuff Muscles [12]

Long Head of Biceps Tendon, Bicipital Anchor and Pulley System

The long head of the biceps tendon originates mostly from the supraglenoid tuberosity and partly from the superior labrum, and has a common attachment with the superior glenohumeral ligament. This conjoined structure is called ‘biceps labral complex’ or bicipital anchor, where the fibrous tissue of the labrum blends with the biceps tendon. It may originate from anterior, posterior or both aspects of the labrum. The tendon passes within the joint, between the supraspinatus tendon and the subscapularis tendon through the ‘rotator interval’. The long head of biceps tendon is secured within the bicipital groove by the ‘transverse humeral ligament’ which passes between the greater and lesser tuberosities.

The biceps pulley, also known as ‘biceps sling’, is comprised of a combination of the coracohumeral, superior glenohumeral and transverse humeral ligaments. It is best seen on axial images as a circular structure, in the intertubercular groove. The tendon of the short head of the biceps muscle is anterior to the humeral head.

Three types of biceps labral complex have been described. In type 1 the biceps labral complex has a firm attachment to the superior glenoid rim (no sublabral sulcus). Types 2 and 3 are classified according to the depth of the sublabral sulcus. Type 2 forms a small sulcus at the superior pole of glenoid. Type 3 is large sublabral sulcus which extends under the labrum and over the cartilaginous portion of the glenoid fossa.[14] One of the most common variants is the accessory head of the biceps muscle. It is thought to be present in 9.1–22.9% of the population. Knowledge of this variant is important as it may be mistaken for a longitudinal split tear of the long head of the biceps tendon.[15]

Rotator Interval

The rotator interval contains the biceps tendon, coracohumeral ligament, superior glenohumeral ligament, rotator interval capsule, anterior fibers of supraspinatus tendon, and the superior fibers of the subscapularis tendon. It is a triangular area between anterior border of the supraspinatus tendon and superior border of the subscapularis tendon, from the coracoid process to the biceps groove. The roof of this space is formed by the anterior part of the superior complex (the superior glenohumeral ligament and coracohumeral ligament).Its inferior border is formed by the middle glenohumeral ligament.[1,23]

Bursae

The important bursae around shoulder joint are the subacromial, subdeltoid, subscapular, and subcoracoid bursae. The subacromial and subdeltoid bursae are sometimes seen as a large continuous bursa called subacromial subdeltoid bursa. It is bounded superiorly by the deltoid, acromion, and coracoacromial ligament and inferiorly by the rotator cuff, mainly the supraspinatus. Under normal circumstances it does not communicate with the joint space and is not seen on MRI unless it is distended by fluid. However, in cases of a rotator cuff tear, a communication develops between the two spaces.

The subcoracoid bursa is located between the subscapularis muscle and the coracoid process. The subscapular bursa is located between the anterior surface of the scapula and the subscapularis muscle. The

subcoracoid bursa does not communicate with the glenohumeral joint, it may communicate with the subacromial subdeltoid bursa in about 10% of patients. The normal subcoracoid bursa is usually not identified on MRI unless distended by fluid.

ROTATOR CUFF TEARS

MR provides information about rotator cuff tears such as tear depth or thickness, tendon retraction, and tear shape which can influence treatment selection and help determine the prognosis. It also tells about, tear extension to adjacent structures, muscle atrophy, and fatty degeneration which have implications for the physiologic and mechanical status of the rotator cuff. Lastly, information about the coracoacromial arch and impingement can be obtained with MR imaging.

The dimensions of rotator cuff tears have implications for selection of treatment and surgical approach, postoperative prognosis, and tear recurrence. Primary repair is usually not possible when both the length and the width of the tear exceed 4 cm at preoperative MR imaging.[33]

Partial thickness rotator cuff tears (PTRCTs) are a common pathology that may significantly impact a spectrum of work done .Despite their high prevalence, most of the studies on the treatment of rotator cuff tears have focused on full thickness tears. PTRCTs are relatively ignored and the treatment of PTRCTs remains controversial.

Based on come cadaveric and imaging studies.[34-37], the prevalence of PTRCTs ranges from 13% to 32%. However, the true prevalence of PTRCTs be underreported.

Etiology and Pathogenesis

The etiology and pathogenesis of rotator cuff tears is multifactorial with both intrinsic and extrinsic factors contributing to it. Intrinsic factors include age-related microscopic changes like hypocellularity, fascicular thinning and decreased vascularity of the tissues, which predispose a tendon to degenerative tearing and alterations in intratendinous strain.[38-39]

Extrinsic factors include subacromial impingement, glenohumeral instability, and internal impingement.[40-42] Finally, traumatic events, either singular in nature or repetitive (e.g., overhead athlete), can contribute to tensile overload and fiber failure of the rotator cuff. The presumption is that because of increased tendon strain due to the presence of a tear, PTRCTs generally increase in size over time.[43]

PTRCTs can be classified by location (articular, bursal, and intratendinous)

The treatment of PTRCTs is multifactorial and is influenced by various factors like the patient's age, symptoms, functional deficit, size of the tear, tear location (e.g., bursal versus articular) and the nature of onset (e.g., degenerative versus traumatic).

In the majority of cases, a trial of non-operative treatment is reasonable since, unlike full thickness rotator cuff tears, risk of fatty infiltration, muscle atrophy, and tear extension are relatively minimal.

The **Patte classification** describes the amount of supraspinatus tendon retraction in a complete tear:

stage1: proximal stump is near the bony insertion

stage2: proximal stump is at the level of the humeral head

stage3: proximal stump is at the level of glenoid or more proximal

Repair of a rotator cuff tear will not result in optimal functional outcome if the ability of the muscle to contract is irreversibly lost, primarily due to muscle atrophy.[44]

A method of identifying supraspinatus muscle atrophy is the tangent sign.[45] With use of an MR imaging plane and bone landmarks, a normal supraspinatus muscle should cross superior to a line drawn through superior borders of the scapular spine and the superior margin of the coracoid process.

Fatty degeneration of rotator cuff muscles may occur in rotator cuff tear, as a result of large, long-standing tendon tears. In addition, fatty degeneration may also occur in the infraspinatus muscle with an intact infraspinatus tendon in the presence of large anterosuperior rotator cuff tendon tears.[46]

SHOULDER JOINT DISLOCATIONS

The majority of traumatic glenohumeral dislocations are anterior, and the remainder are usually posterior and inferior. Superior dislocations are rare. The most common mechanism of acute dislocation usually involve some variation of a fall onto an outstretched hand.

Anterior dislocation

Approximately 85% of initial shoulder dislocations are anterior and are most commonly seen in patients 10–20 years old after a discrete traumatic injury.[47-50] Anterior dislocations more commonly involve “indirect” mechanisms i.e due to sudden loading of the arm in varying degree of abduction, external rotation, and extension. They are less commonly due to “direct” injury mechanisms after a direct impact to the posterior aspect of the shoulder.[49,50]

Multiple osseous and soft-tissue injuries are associated with anterior dislocations. The most common are Soft-tissue Bankart lesion: Injury to anteroinferior glenoid labrum with no connection to scapular periosteum.

Osseous Bankart lesion: Injury to the bony glenoid rim Perthes lesion: Avulsion of the anteroinferior labrum, in this the scapular periosteum is stripped medially but the periosteum remains connected to the detached labral component Anterior labroligamentous periosteal sleeve avulsion (ALPSA): the avulsed anteroinferior labrum is displaced inferomedially from the glenoid while maintaining its attachment to the glenoid periosteum.

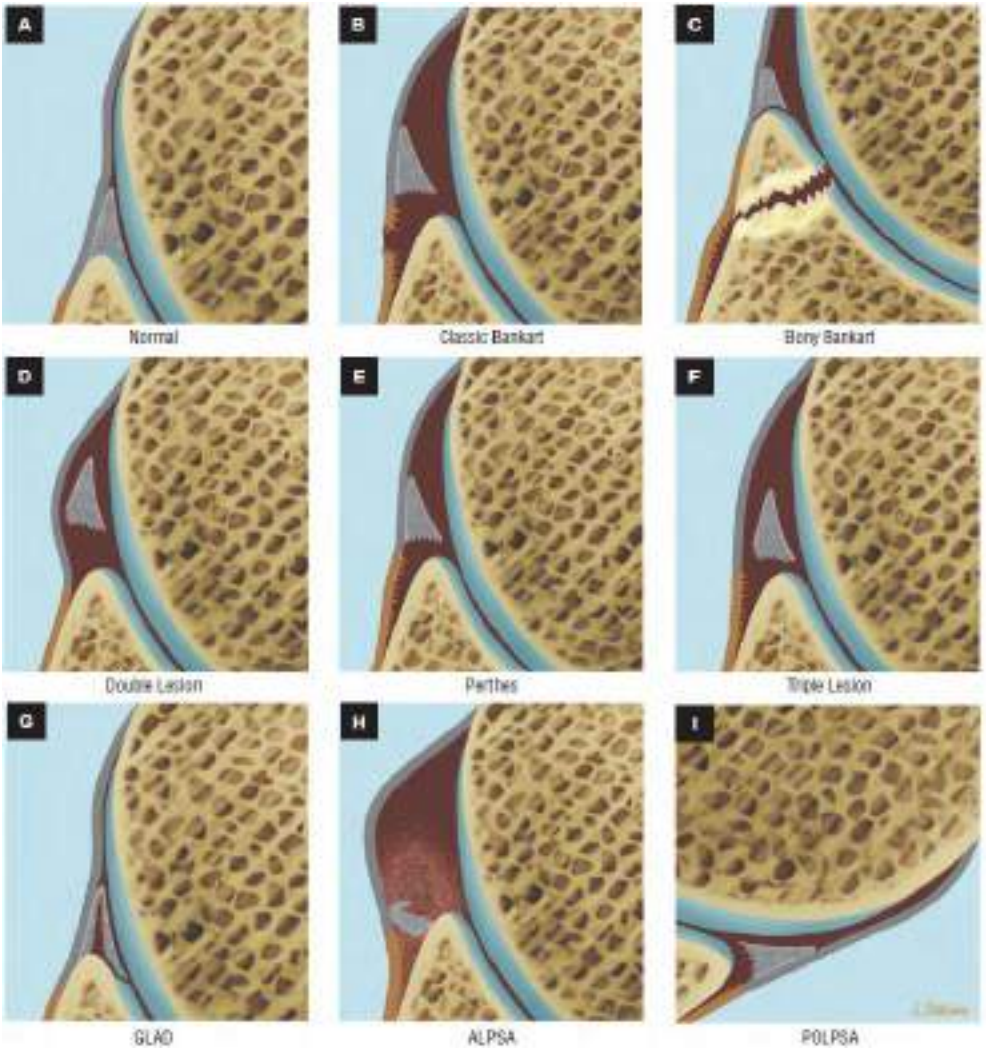

Figure: 7 Graphical representation of lesions associated with anterior dislocation.[12]

Humeral avulsion of the glenohumeral ligament (HAGL) : it is a simple avulsion of anterior band of the inferior glenohumeral ligament from the humeral attachment. The soft Bankart lesion involves disruption of the anteroinferior capsuloligamentous complex, specifically middle and inferior glenohumeral ligaments, occurring in up to 85% of cases that go on to develop recurrent instability.[51-53] Perthes and ALPSA lesions also compromise the stabilizing function of the glenohumeral ligaments, most importantly the anterior band of inferior glenohumeral ligament.[54]

Posterior Dislocation

Approximately 2–5% of reported glenohumeral dislocations are posterior, however true incidence is difficult to estimate because of

high frequency of missed diagnoses due to failure of recognition of the radiographic signs on initial imaging.[51] Most notable mechanism of posterior dislocation is axial loading of the arm while adducted, flexed, and internally rotated.[48,50,54,55] Posterior dislocations also occur with forced global muscular contraction such as seen in seizure or electric shock.[48,51,56]

Traumatic posterior dislocations are commonly associated with

Reverse Hill-Sachs lesion: it is a compression deformity of the anteromedial humeral head.

Reverse soft tissue and osseous Bankart lesions: posterior labral tear and posterior glenoid rim fracture.

Posterior labrocapsular periosteal sleeve avulsion (POLPSA)

Reverse HAGL lesion: Humeral avulsion of the posterior band of the inferiorglenohumeral ligament.[55,56]

Full-thickness rotator cuff tears, often associated with a fracture of lesser tuberosity.[57,58]

Proximal humerus fractures

Inferior dislocation

Inferior glenohumeral dislocations account for approximately 0.5% of shoulder dislocations.[59] It is commonly seen on falling onto an outstretched and significantly abducted arm, with impact causing hyperabduction of the arm. High-energy mechanisms are commonly implicated in inferior dislocations.[47,59]

SLAP TEARS

These are tears of the superior labrum near to the origin of the long head of biceps. It is usually seen in overhead throwers and in swimmers .Classification of slap tears (adapted from stoller magnetic resonance imaging in orthopedics and sports medicine).[12]

Type 1 SLAP lesions have frayed and degenerated superior labrum with a normal biceps tendon anchor.

Type 2 SLAP lesion has labral fraying and also have detached superior labrum and biceps anchor, making it unstable. In a type 2 SLAP lesion there is a gap between the glenoid articular cartilage and the attachment of the superior labrum and biceps anchor.

Displacement of the labrum of more than 3 to 4 mm is usually associated with abnormal superior labrum and biceps anchor attachment.

Type 3 SLAP lesions is a bucket-handle tear of the superior labrum without extension into the biceps tendon. The biceps anchor is stable and the remaining labrum is intact.

Type 4 SLAP lesions involves a bucket handle tear of the superior labrum with extension into the biceps tendon

Type 5 SLAP lesion is a SLAP 2 or 3 lesion plus superior extension of a Bankart lesion

Type 6 SLAP lesions are flap tears of the superior labrum.

Type 7 SLAP lesions are SLAP 2 or SLAP 3 lesions with extension into the middle glenohumeral ligament

Type 8 SLAP lesions are SLAP 2 or SLAP 3 lesions with a posterior labral tear.

Type 9 SLAP lesions are circumferential labral tears with anterior and posterior labral involvement.

Type 10 SLAP lesions are SLAP 2 or 3 lesions plus extension into the rotator cuff interval through the superior glenohumeral ligament.

AIMS AND OBJECTIVES

1) To study the spectrum of MRI changes in Rotator cuff pathologies and glenohumeral instability.

2) To correlate with arthroscopic findings wherever possible.

REVIEW OF LITERATURE

Shoulder is a complex joint with various pathologies present in a similar clinical fashion. Clinical examination is the initial form of evaluation which is usually followed by conventional radiology and Computed tomography. These two modalities give a reasonable information about bony structures, but lack spatial resolution in diagnosing soft tissue pathologies. MRI and MR arthrography help in better evaluation of soft tissues. Few of the earlier studies stated that MRI alone without arthrography is insufficient in diagnosing rotator cuff pathologies and glenohumeral instabilities, but with advent of higher tesla MRI equipments and better understanding of the joint, we can fairly say that MRI is very useful in differentiating various pathologies and hence preventing unnecessary intervention. Following studies have compared MRI, MR arthrography and arthroscopy for rotator cuff and glenohumeral pathologies.

Ianotti J P et al(1991) evaluated the sensitivity, specificity, and predictive value of magnetic resonance imaging in the diagnosis of lesions of the rotator cuff, glenohumeral capsule, and glenoid labrum in ninety-one patients and fifteen asymptomatic volunteers. Magnetic resonance imaging demonstrated 100 per cent sensitivity and 95 per cent specificity in the diagnosis of complete tears, and it consistently predicted the size of the tear of the rotator cuff. There was a definite correlation between atrophy of the supraspinatus muscle and the size of a complete, chronic tear of the rotator cuff.[60]

Timothy el workman et al(1992) retrospectively analysed the diagnostic interpretations at plain film radiography, arthroscopy and MR imaging in 76 patients. The analysis revealed that neither radiography nor arthroscopy displayed the lesion with sufficient accuracy to represent a true standard of reference for evaluation of MR imaging in the diagnosis of hill sachs lesion. The data from the diagnostic interpretations were analysed in three ways, each of which revealed that findings at MR imaging were more helpful than findings at radiography and/ or arthroscopy in the diagnosis of hill sachs lesion.

When the agreement of findings in two or three methods was used to assign a final diagnosis, MR imaging resulted in sensitivity of 97%, specificity of 91 % and accuracy of 94 % in the detection of hill sachs lesion.[61]

V.P Chandani et al (1993) prospectively compared MR imaging, MR arthrography and CT arthrography in 30 patients who had either signs and symptoms of shoulder instability or shoulder pain of unexplained origin to determine the sensitivity of each technique in detecting glenoid labrum tears and in determining whether the labrum is detached or degenerated. They concluded that MR arthrography and MR imaging both showed labral tears with greater sensitivity than CT arthrography did. MR imaging and MR arthrography also enabled direct visualization of rotator cuff disease and other unsuspected anomalies.[62]

K Yeu et al(1994) evaluated ten patients with a painful shoulder requiring operation who received an MRI of the shoulder before surgery. The sensitivity of MRI for rotator cuff tear in this study was 0.89. The overall accuracy was 80%. They concluded that MRI has a high accuracy in detecting the rotator cuff tear. False-positive and false-negative diagnoses were attributed to a severe tendinitis and an incomplete tear, respectively.[63]

E T Torstensen et al(1999) evaluated Fifty-seven subjects with shoulder pain with magnetic resonance imaging (MRI) and arthroscopy. With arthroscopy as the standard of reference, the accuracy of MRI for diagnosing shoulder disease was assessed. MRI identified 11 of the labral injuries, with accuracy of 62%, sensitivity 73%, and specificity 58%. Rotator cuff tears were identified on MRI with accuracy of 68%, sensitivity 96%, and specificity 49%. When partial rotator cuff tears were differentiated from complete tears, only 16 of 24 injuries were identified on MRI. Nonrotator cuff, nonlabral disease was identified with accuracy of 75%, sensitivity 63%, and specificity 87%.[64]

Davidson JF et al((2005) evaluated Shoulder MRI scans of Sixty-six preoperatively. The maximum medial to lateral length (L) of the tear was measured on T2-weighted coronal cuts. The maximum anterior to posterior width (W) was measured on T2-weighted sagittal cuts. The cases were divided into 3 groups: group 1, short-wide tears, L < or = W, L < 2 cm; group 2, long-narrow tears, L > W, W < 2 cm; and group 3, long-wide tears, L > or = 2 cm, W > or = 2 cm. and concluded that Tear pattern and method of repair can be predicted on high-quality MRI scan. Group 1, L < or = W and L < 2 cm, predicts a crescent-shaped tear and end-to-bone repair (positive predictive value, 93.8%). Group 2, L > W and W < 2 cm, predicts a longitudinal tear and side-to-side/margin convergence repair (positive predictive value 100%). Group 3, L > or = 2 cm and W > or = 2 cm, predicts a massive contracted tear and that primary end-to-bone or side-to-side repairs are usually not possible and that interval slides or partial repair may be necessary (positive predictive value, 76.5%). The overall diagnostic model based on usable MRI scans significantly predicted arthroscopic findings.[65]

Thomas H Magee et al (2006) performed MRI examination on 100 patients between October and December 2014. All 100 patients presented with shoulder pain, instability or both and concluded that 3.0 T MRI of shoulder joint is very sensitive and specific compared with arthroscopy in detection of superior, anterior, and posterior labral tears.[66]

Magee T et al(2006) evaluated 150 patients who subsequently went arthroscopy. The radiologists interpreted the MR images by consensus without knowledge of the arthroscopy results. Scans were interpreted for full-thickness or partial-thickness supraspinatus tendon tears. If partial-thickness supraspinatus tendon tears were seen on MRI, the reviewers categorized the partial-thickness tear into articular or bursal . The radiologists also categorized the supraspinatus tendon tears into small (< 1 cm retraction from the humeral head) and large (> 1 cm retraction from the humeral head) and concluded that 3.0T MRI is

highly sensitive and specific compared with arthroscopy in the detection of full thickness and partial thickness supraspinatus tear.[67]

Kirkley, Alexandra MD et al(2006) studied Sixteen patients, aged 18 to 30 years, for Correlation between arthroscopy and magnetic resonance imaging and concluded that Magnetic resonance imaging can be considered a valuable tool for the detection of Hill-Sachs and Bankart lesions associated with primary traumatic anterior dislocations of the shoulder. Its ability to detect other pathologic lesions, however, is limited.[68]

A Lambert et al(2009) correlated surgical and imaging findings for 48 patients who underwent surgery for rotator cuff tear and concluded that 3.0T MRI is valuable for detection of small tears, especially for partial thickness tears due to increased spatial resolution and the surgical candidates and surgical planning are improved due to more accurate measurements of tear size and quality if the tendon edges.[69]

Meredith L. Hayes et al (2010) studied 87 consecutive patients who underwent diagnostic MRI and shoulder arthroscopy for instability from 1997 to 2006. MR images were reviewed by two radiologists and interpreted by consensus for the presence of articular cartilage lesions (including Hill–Sachs and Bankart lesions), which were then confirmed by reviewing the operative report and images recorded at arthroscopy and concluded that Magnetic resonance imaging demonstrates high sensitivity and specificity for the diagnosis of articular cartilage injuries in patients with glenohumeral instability.[70]

Guido Garavaglia et al (2014) reviewed the medical charts of a total of 348 consecutive arthroscopic rotator cuff repairs. There were 311 supraspinatus tears (89%), 48 infraspinatus tears (14%), and 129 subscapularis tears (37%). MRI sensitivity and specificity were respectively 0.25 and 0.98 for subscapularis tendon tears, 0.67 and 1.0 for supraspinatus tears and 0.5 and 0.99 for infraspinatus tears.[71]

Andrew J K Ostör et al(2013) compared clinical examination versus magnetic resonance imaging and arthroscopy for the detection of rotator cuff lesions in 117 patients. They found that For clinical examination, sensitivity and specificity to detect a tear or rupture of

supraspinatus were 30 % (16/54) and 38 % (15/40) and, for the detection of any pathology, were 94 % (67/71) and 22 % (5/23), respectively, compared with arthroscopy. Correspondingly, the sensitivity of MRI compared with arthroscopy to detect a tear or rupture of supraspinatus was 90 % (28/31) with a specificity of 70 % (46/53), whereas for the detection of any abnormality, the sensitivity was 92 % (65/71) with a specificity of 48 % (11/23). The sensitivity of detecting any rotator cuff abnormality is high when examination and MRI is compared with arthroscopy with the specificity being greater with MRI than examination.[72]

Utkarsha Pradeep Joshi et al (2014) did A prospective study of 30 patients of shoulder instability, The patients were first examined clinically, followed by 1.5 tesla MRI scan and finally arthroscopically. The findings of diagnostic arthroscopy were correlated with clinical & MRI findings. By obtaining correlation between clinical examination, MRI scan and arthroscopy for anterior and posterior shoulder instability, concluded that MRI can give a better diagnosis of the pathology in comparison to clinical examination.[73]

KM Muthami et al(2014) evaluated 34 patients with an aim of establishing the accuracy and sensitivity of MRI in the diagnosis of rotator cuff pathology in relation to arthroscopic findings. They concluded that sensitivity of MRI in diagnosing of rotator cuff pathology was low but the specificity was high. Given the relatively low sensitivity findings of the study compared to previous studies done elsewhere there is need to have a trained dedicated musculoskeletal radiologist. However, there exists a significant correlation between the diagnoses made under MRI and arthroscopy.[74]

Omid R Momenzadeh et al (2015) evaluated 80 patients with shoulder joint disorders who underwent arthroscopy and concluded that the MRI can be a useful tool in ruling out possible abnormalities in the shoulder and to give clues to the most probable diagnosis.[75]

Nevin et al (2016) compared 60 patients complaining of shoulder pain. Conventional MRI and MR arthrography were done for all cases. The musculoskeleral radiologists reviewed the images for evidence of

labroligamentous complex and concluded that however MRI cannot replace MR Arthrography but the could be a potent tool for diagnosis of the main pathological affection of the shoulder joint guided by the type of population , which proved to have good impact on diagnosis.[76]

Abhinav Bhatnagar et al(2016) evaluated 39 patients of chronic shoulder pain and restricted shoulder movements and concluded that rotator cuff pathologies is the most common pathology and that MRI is effective in diagnosing rotator cuff tears, Bankart's tear and osteochondral defects but was not found to be helpful in diagnosing SLAP lesions. MRI and arthroscopy have complimentary roles in the diagnosis of shoulder pathology.[77]

Gururaj Sharma et al (2017) evaluated A total of 82 patients were diagnosed with rotator cuff injury on MRI during this period, out of which 45 patients who underwent further evaluation with arthroscopy and concluded that MRI revealed high sensitivity and specificity for the diagnosis of rotator cuff tears and MRI provides useful information about the size and extent of the tear, involvement of adjacent structures, presence of muscle atrophy and tendon retraction, all of which have important therapeutic and prognostic implications.[78]

Yogesh Sharma et al (2019) did a diagnostic evaluation study, estimating the accuracy of MRI in diagnosing lesions encountered in shoulder dislocations vis-a-vis shoulder arthroscopy. Ninety participants of anterior shoulder dislocation were evaluated preoperatively with a shoulder MRI. The study participants were later subjected to a diagnostic shoulder arthroscopy and managed operatively and concluded that MRI is a very sensitive and specific tool in the detection of lesions commonly associated with shoulder instability, namely Bankart and Hill–Sachs lesions.[79]

MATERIALS AND METHODS

7.1 Source of Data

It was a prospective study of clinically suspected patients of rotator cuff pathologies and glenohumeral instability who underwent MRI of shoulder joint in the department of Radiodiagnosis, Dayanand Medical College and Hospital, from December 1 , 2019, to May 1 , 2021.

7.2 METHOD OF COLLECTION OF DATA

Patients suspected clinically to have rotator cuff pathologies/ glenohumeral instability and referred to the department were included in study. Consent was obtained from each patient and relevant detailed history was elicited from all patients. Before starting MRI study, the procedure was explained to the patients in his/her vernacular language to allay anxiety and fear. Written informed consent was taken.

INCLUSION CRITERIA:

- Patients who were clinically suspected to have rotator cuff pathology.
- Patients with shoulder dislocations
- Patients with pain and restricted shoulder movement and diagnosed on MRI imaging as having glenohumeral instability or rotator cuff pathologies.

EXCLUSION CRITERIA:

- Patients who have undergone prior shoulder surgeries
- Any contraindication to MRI as per checklist on departmental MRI form.
- Anyone not willing to participate in study

MR IMAGING TECHNIQUE

All patients underwent a multiplanar, multi sequential MRI scan of shoulder joint on a MAGNETON SKYRA 48 Channel 3 Tesla MR Scanner by Siemens, Germany.

Sequences	PD FS axial	T1 axial	PD FS Coronal	T2FS coronal	T2 coronal	PD FS sagittal	T1 sagittal
Acquisition time	2:53	1:58	3:15	2:37	2:26	2:30	1:45
Orientation	Axial	Axial	Coronal	Coronal	Coronal	Sagittal	Sagittal
Number of slices	256x320	269x384	269x384	256x384	269x320	256x320	269x384
No. of slices	25	25	21	21	21	23	23
FoV read(mm)	140	140	150	160	140	140	140
FoVPhase(%))	100	100	100	100	100	100	100
Slice thickness(mm	3	3	3	3	3	3	3
Slice gap(mm)	1.7	1.7	0.5	0.5	0.5	0.7	0.7
Repetition time(msec)	3000	538	3800	3800	3800	4000	478
Echo time(msec)	32	11	35	73	78	34	11
Flip angle (deg)	150	150	150	150	150	150	150
Fat suppression	Yes	No	Yes	Yes	No	Yes	No
Flow compression	Read	No	Read	Read	No	Read	No
Phase enc. Dir.	A>>P	A>>P	A>>P	A>>P	A>>P	F>>H	H>>F

OUTCOME

The study focussed on non-invasive detailed evaluation of rotator cuff pathologies and glenohumeral instabilities so as to optimize management of patients.

STATISTICAL ANALYSIS:

Data was described in terms of range; mean ±standard deviation (± SD), frequencies (number of cases) and relative frequencies (percentages) as appropriate. All statistical calculations were done using SPSS (Statistical Package for the Social Science) SPSS 21 version statistical program for Microsoft Windows.

OBSERVATION AND RESULTS

I)Age wise distribution of rotator cuff and glenohumeral pathologies:

1) Of the 70 patients studied, the age of the patients with rotator cuff and glenohumeral pathologies ranged from 17 to 77 years, with a mean of 47-48 years. Age wise distribution of shoulder pathologies is shown in Table (1) and Figure (8).

Table 1: Age wise distribution of shoulder pathologies n=70

AGE	No. of cases	Percentage
<20	6	8.6%
21-30	9	12.9%
31-40	12	17.1%
41-50	10	14.2%
51-60	12	17.1%
61-70	18	25.7%
> 70	3	4.3%
Total	70	100.0%

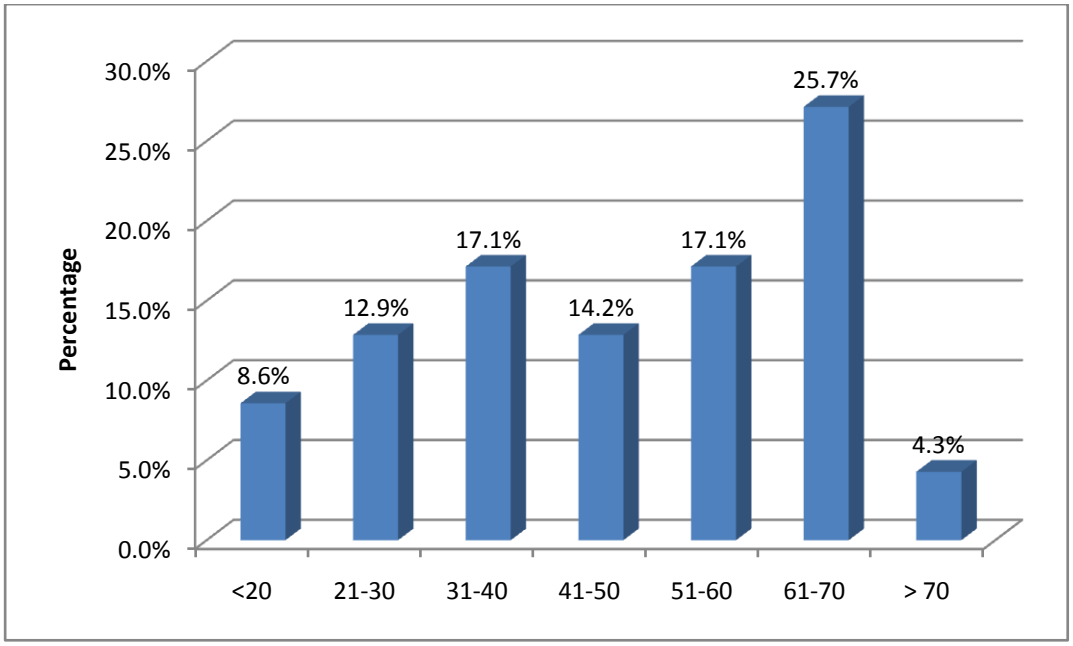

Figure 8: Bar graph of age wise distribution of shoulder pathologies

2) MRI assessment for rotator cuff tear revealed no tear in <20 year age group, 2 in 21-30 year age group, 6 in 31-40 year age group, 6 in 41-50 year age group, 8 in 51-60 year age group, 15 in 61-70 year age group, 3 in >70 year age group as shown in Table (2) and Figure(9).

Table 2: Age wise distribution of rotator cuff tears n=70

	Rotator cuff tear		Total
Age	Absent	present	
<20	6	0	6
21-30	7	2	9
31-40	6	6	12
41-50	3	6	9
51-60	4	8	12
61-70	4	15	19
> 70	0	3	3
Total	30	40	70

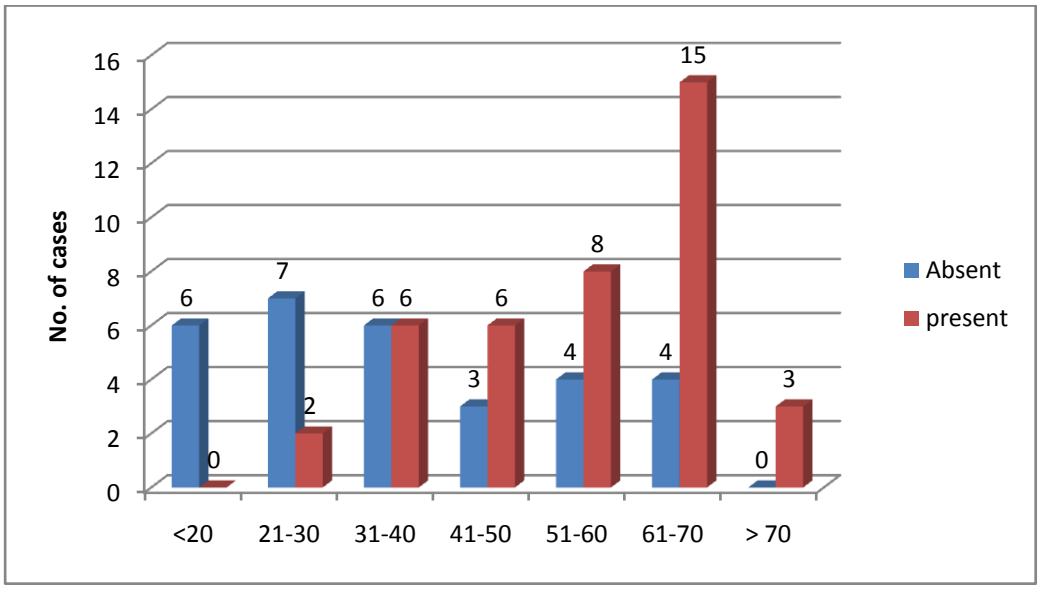

Figure 9: Bar graph showing presence and absence of rotator cuff tears in different age groups

3) MRI assessment of labral tears revealed 4 in <20 year age group, 5 in 21-30 year age group, 5 in 31-40 year age group, 3 in 41-50 year age group, 3 in 51-60 year age group, 7 in 61-70 year age group, 1 in >70 year age group as shown in Table (3) and Figure (10).

Table 3: Age wise distribution of labral tears n=70

	labral tear		Total
Age	Absent	present	
<20	2	4	6
21-30	4	5	9
31-40	7	5	12
41-50	5	4	9
51-60	9	3	12
61-70	13	6	19
> 70	2	1	3
Total	42	28	70

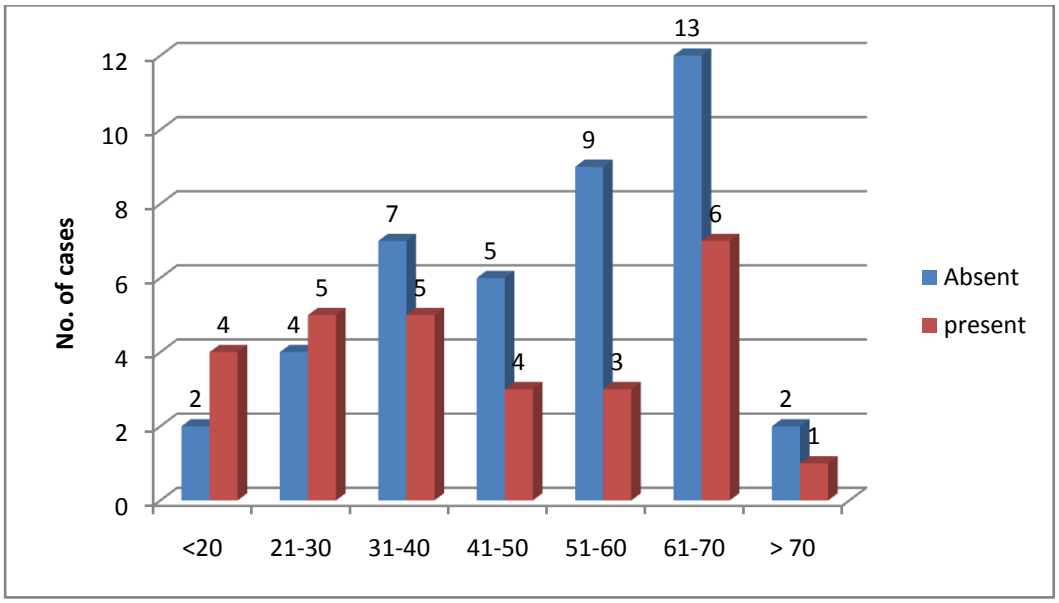

Figure 10: Bar graph showing presence and absence of labral tears in different age groups

4) Various abnormalities seen in supraspinatus and infraspinatus tendon were tendinosis, partial tear or complete tear. Age wise distribution of different pathologies of supra and infraspinatus tendon are shown in Figure(11), (12) and Table (4), (5).

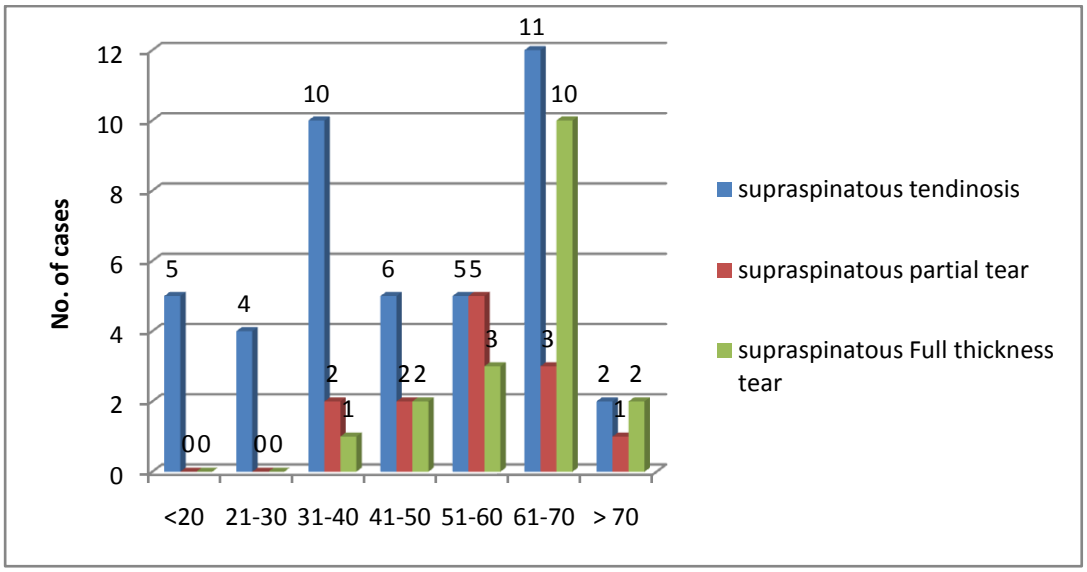

Figure 11: Bar graph showing age wise distribution of supraspinatus pathologies

Table 4: Age wise distribution of supraspinatus pathologies n=70

Age	supraspinatus tendinosis	supraspinatus partial tear	supraspinatus Full thickness tear
<20	5	0	0
21-30	4	0	0
31-40	10	2	1
41-50	6	2	2
51-60	5	5	3
61-70	11	3	10
> 70	2	1	2
Total	43	13	18

Table 5: Age wise distribution of infraspinatus pathologies n=70

Age	Infraspinatus tendinosis	Infraspinatus partial tear	infraspinatus Full thickness tear
<20	0	0	0
21-30	1	1	0
31-40	1	0	1
41-50	1	0	2
51-60	0	0	3
61-70	7	4	6
> 70	1	0	2
Total	11	5	14

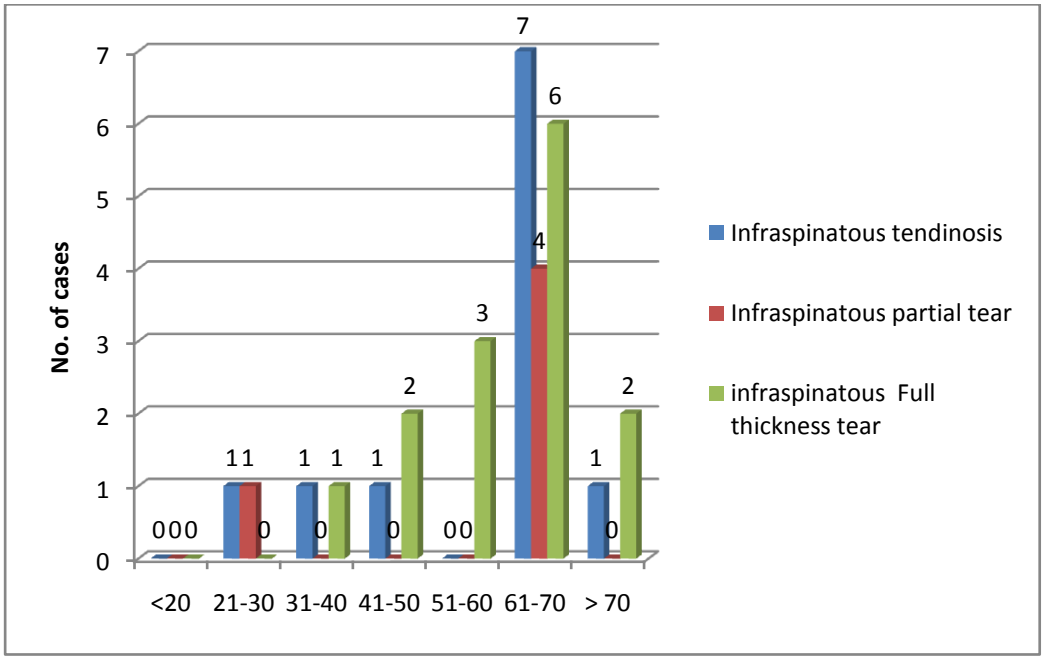

Figure 12: Bar graph showing age wise distribution of infraspinatus pathologies

II) Sex wise distribution of rotator cuff diseases and glenohumeral pathologies

1) Of the 70 patients studied, 26(37.1%) were females and 44 (62.9%) were males as shown in Figure(13

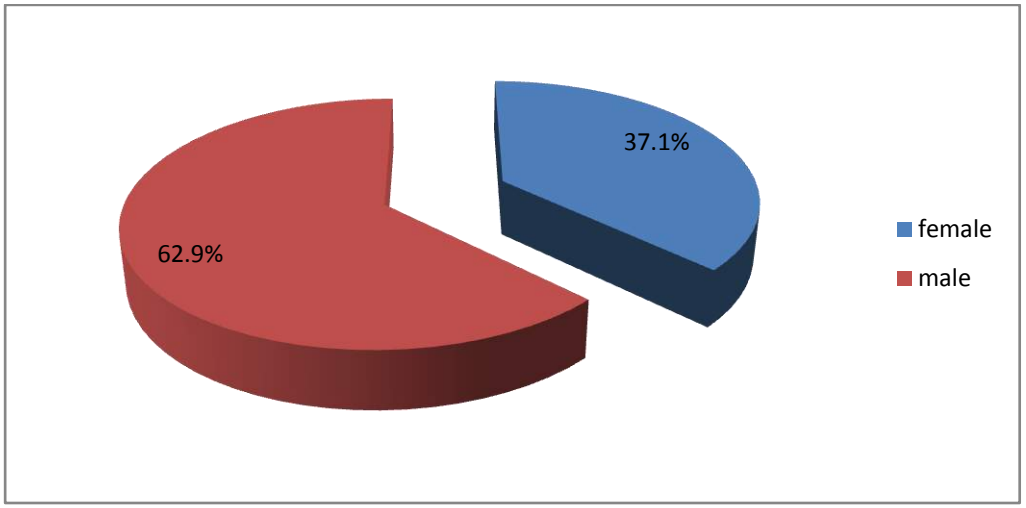

Figure 13: Pie chart of gender distribution of patients with shoulder pathologies

2) In case of rotator cuff tear, out of 40 patients 18 were female and 22 were male as shown in Figure(14) n=40

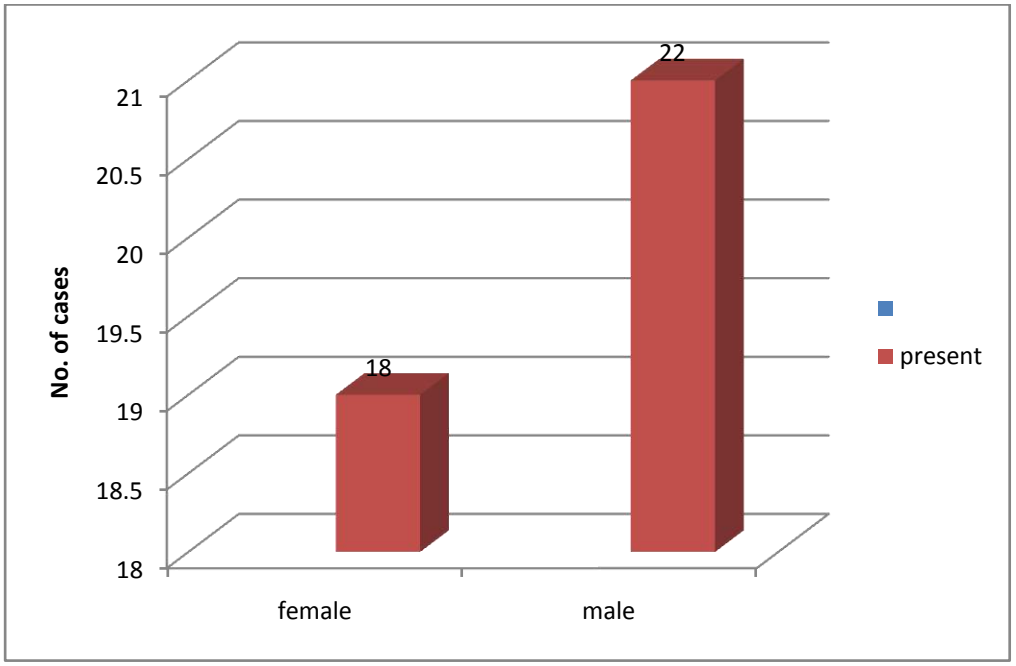

Figure 14: Bar graph of gender distribution of rotator cuff tears

3) In case of labral tears, out of 28 patients 5 were female and 23 were male as shown in Figure (15) n=28

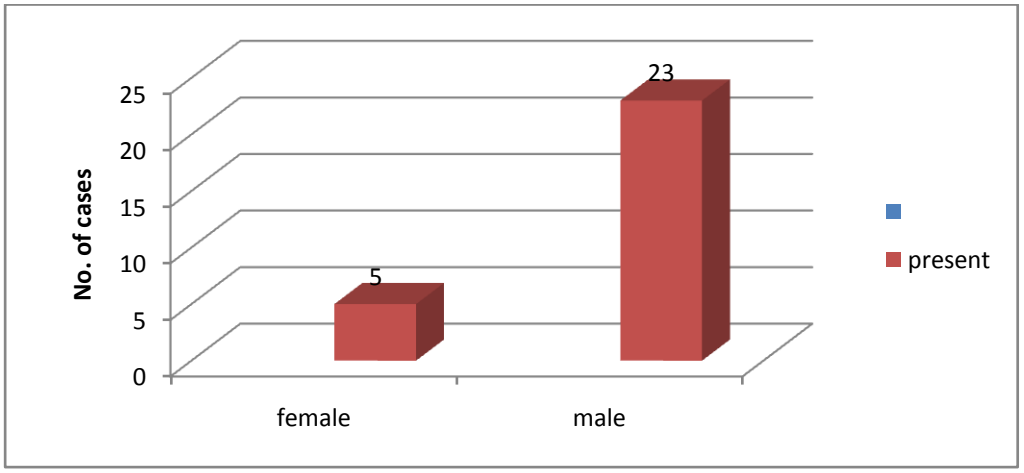

Figure 15: Gender distribution of labral tears

4) Various abnormalities seen in supraspinatus and infraspinatus tendon were tendinosis, partial tear or complete tear. Sex wise distribution of different pathologies of supra and infraspinatus tendon are shown in Figure(16), (17) and Table (6), (7).

Table 6: Gender distribution of supraspinatus pathologies

Sex	Supraspinatous tendinosis	supraspinatus partial tear	supraspinatus Full thickness tear
female	17	4	6
male	26	9	12
Total	43	13	18

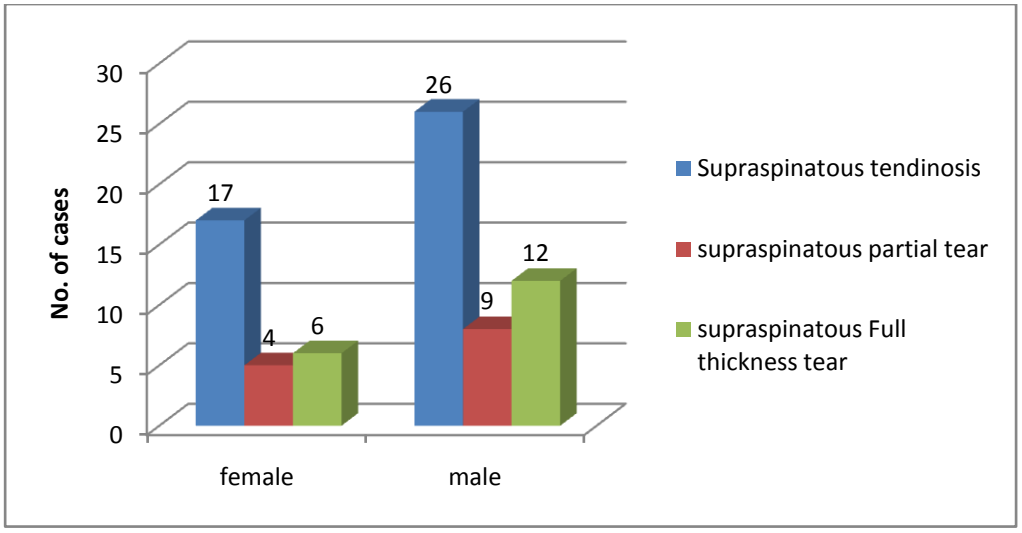

Figure 16: bar chart showing gender distribution of supraspinatus pathologies

Table 7: Gender distribution of infraspinatus pathologies

Sex	Infraspinatus tendinosis	Infraspinatus partial tear	Infraspinatus Full thickness tear
female	6	3	5
male	5	2	9
Total	11	5	14

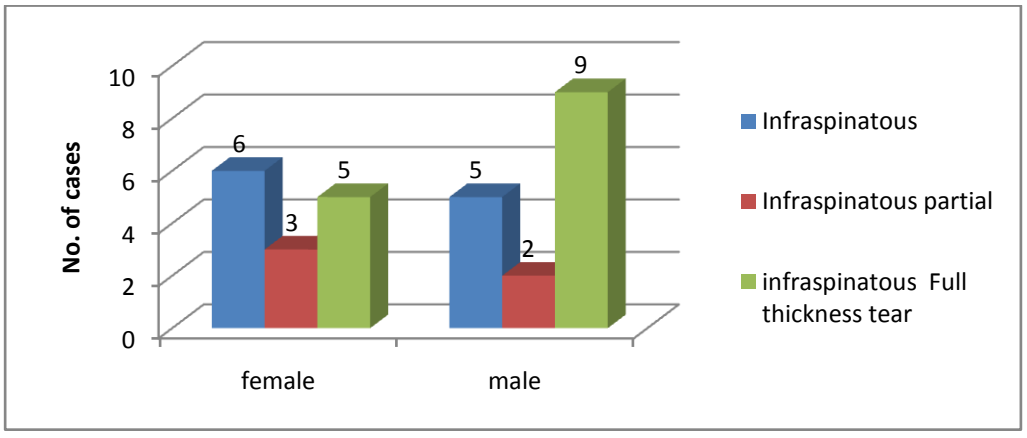

Figure 17: bar chart showing gender distribution of infraspinatus pathologies

III) SPECTRUM OF SHOULDER PATHOLOGIES

The major pathologies which were described in detail in our study were rotator cuff tendinosis, rotator cuff tear, labral degeneration and labral tear. There was considerable overlap in these pathologies in many patients. The prevalence of these diseases in our study is described in Table (8) and Figure (18).

Table 8: Spectrum of shoulder pathologies

	No. of cases	Percentage
Rotator cuff tendinosis	51	72.9%
Rotator cuff tear	40	57.1%
Labral degeneration	20	28.6%
Labrat tear	28	40.0%

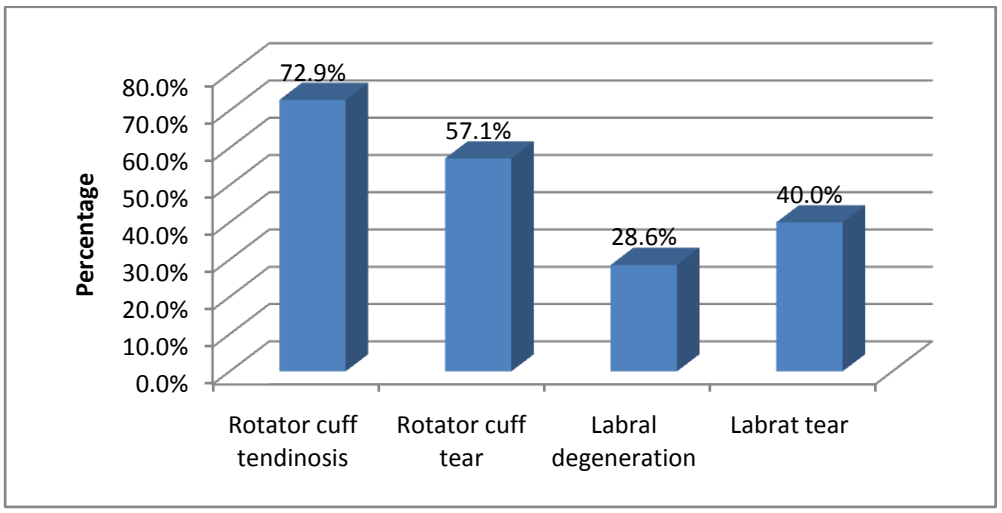

Figure 18: Spectrum of shoulder pathologies

III A) Spectrum of rotator cuff pathologies

The rotator cuff pathologies comprised of impingement resulting in tendinosis or tendinopathy and tendon tears – partial and full thickness tears. Associated and precipitating factors like acromion shape, its angulation , Acromioclavicular joint degeneration were also noted and described as below

Tendinosis/ tendon degeneration of rotator cuff tendons were as follows with supraspinatus tendinosis seen in 43 patients, infraspinatus

tendinosis in 11 patients, teres minor tendinosis in 2 patients and subscapularis tendinosis in 20 patients out of total 70 patients As shown in Table(9) and Figure(19)

Table 9: Distribution of different tendons involved in Rotator Cuff tendinosis

Rotator cuff tendinosis	No. of cases	Percentage
Supraspinatus	43	61.4%
Infraspinatus	11	15.7%
Teres minor	2	2.9%
Subscapularis	20	28.6%

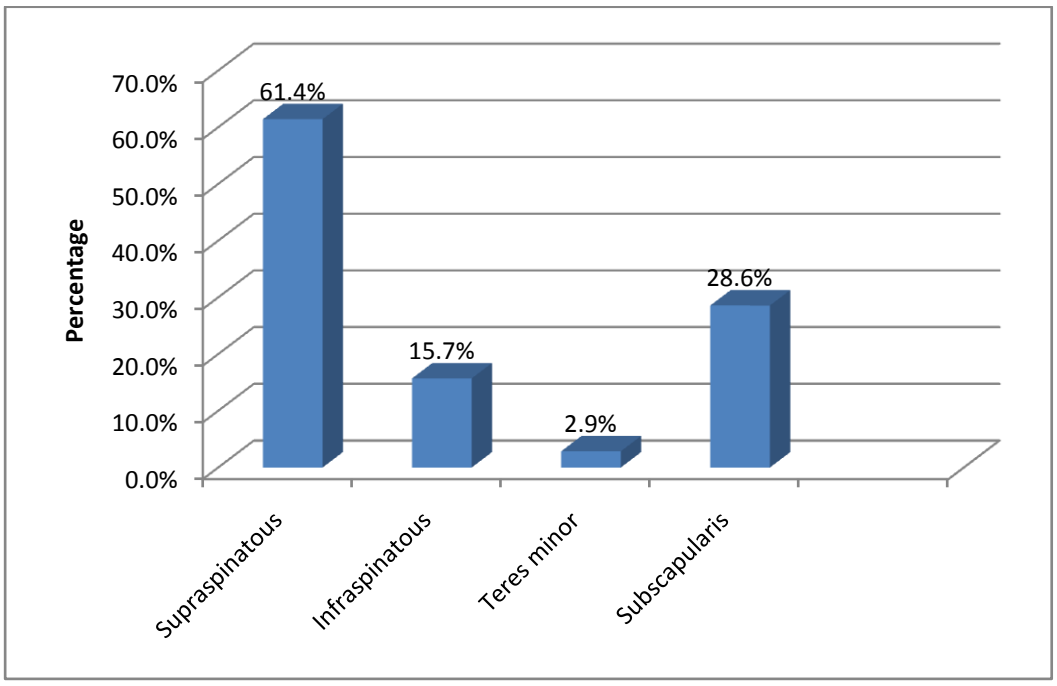

Figure 19: bar diagram of distribution of different tendons involved in Rotator Cuff tendinosis

Supraspinatus tears can be partial thickness or complete thickness. Partial tears are further classified into articular surface, bursal surface tear and intrasubstance tears. Partial supraspinatus tears were seen in 15 patients out of which 10(66.7%) were articular surface, 2(13.3%) were intrasubstance and 3(20%) were bursal surface tears as shown in Table(10) and Figure(20)

Table 10: Distribution of partial supraspinatus tear n=15

supraspinatous partial tear	No. of cases	Percentage
articular surface	10	14.3%
intrasubstance	2	2.9%
bursal surface	3	4.3%

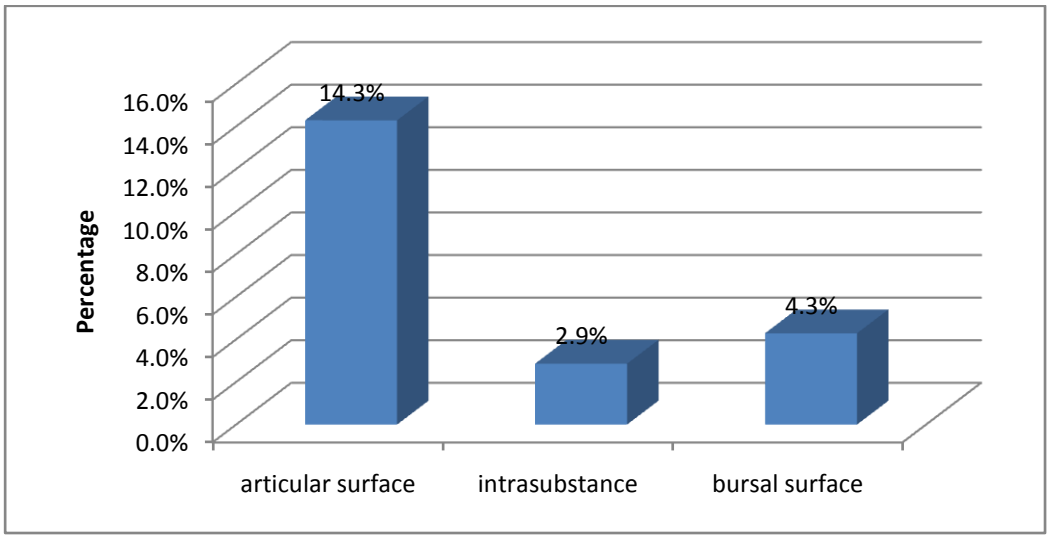

Figure 20: Bar chart showing distribution of partial supraspinatus tear

Full thickness tears can be either complete or incomplete. Full thickness supraspinatus tears were seen in 18 patients , out of which complete tears were seen in 14(77.8%) patients and incomplete tears were is seen 4(22.2%) patients as shown in Table(11) and Figure(21)

Table 11 : Distribution of full thickness supraspinatus tear n=18

supraspinatus	No. of cases	Percentage
complete full thickness tear	14	77.8%
incomplete full thickness tear	4	22.2%
total	18	100.0%

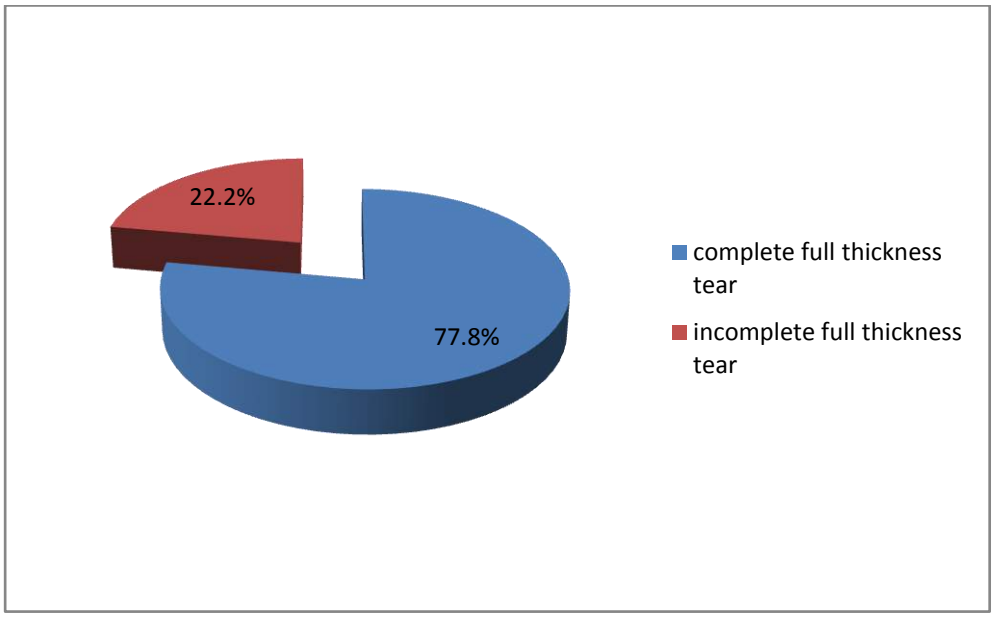

Figure 21: Pie chart of distribution of full thickness supraspinatus tear

Out of total 70 patients in the study , partial tears of subscapularis tendon were seen in 15(21.4%) patients and full thickness subscapularis tear was seen in 1 patient as shown in Table (12), (13) and Figure(22), (23)

Table 12 : Distribution of partial subscapularis tears n=70

Subscapularis partial	No. of cases	Percentage
absent	55	78.6%
present	15	21.4%
Total	70	100.0%

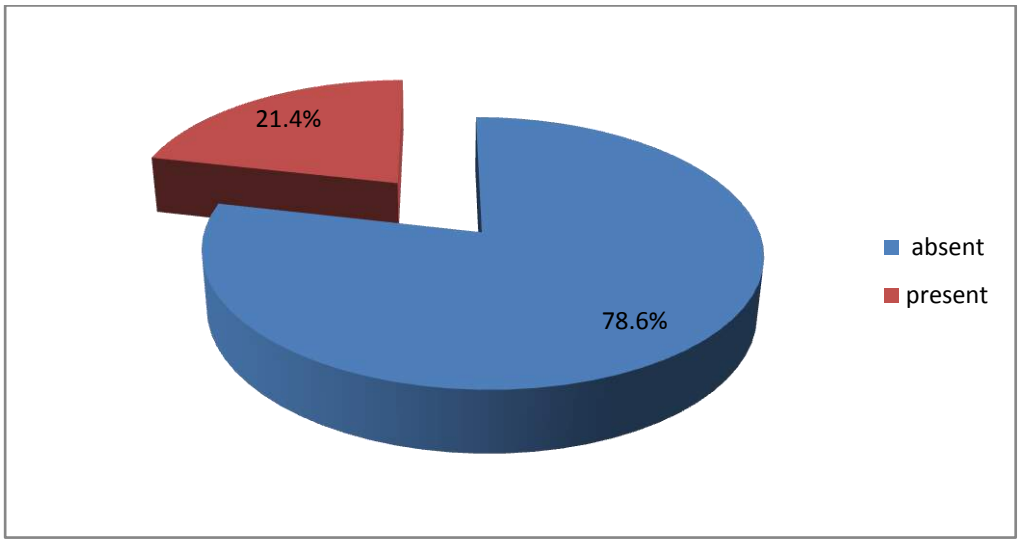

Figure 22: Pie chart of distribution of partial subscapularis tears

Table 13 : Distribution of full thickness subscapularis tears n=70

Subscapularis full thickness	No. of cases	Percentage
absent	69	98.6%
present	1	1.4%
Total	70	100.0%

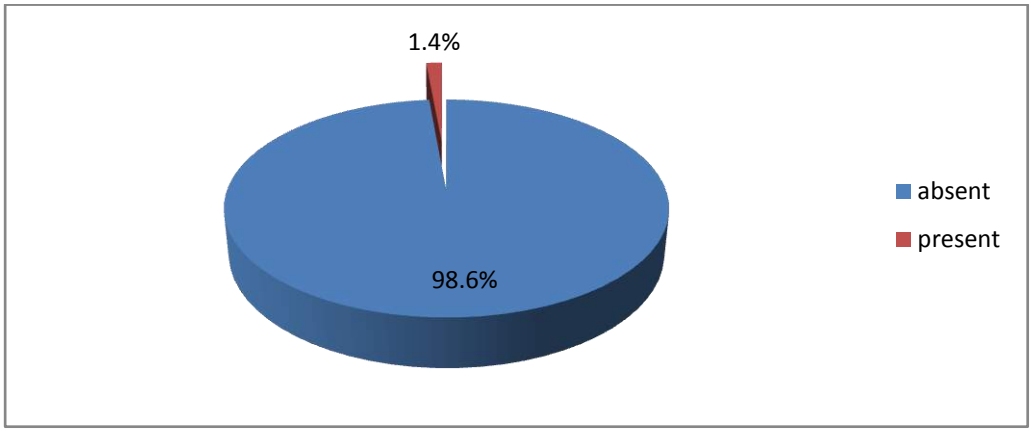

Figure 23: Pie chart of distribution of full thickness subscapularis tears

Based on the shape, the acromion was divided into 4 types. Distribution of various types of acromion are described in Table(14) and Figure(24)

Table 14: Distribution of patients on basis of types of acromion n=70

Acromion type	No. of cases	Percentage
type 1	8	11.4%
type 2	57	81.4%
type 3	2	2.9%
type 4	3	4.3%

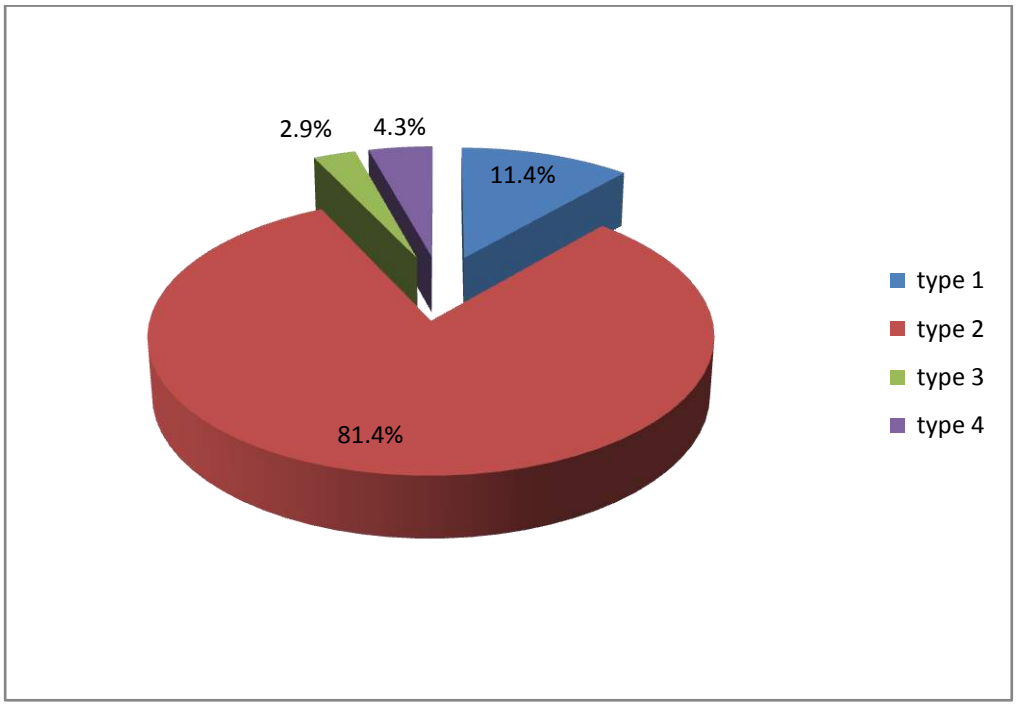

Figure 24: Pie chart of distribution of patients on basis of types of acromion

Acromial Spur, which is a bony spur at the inferior aspect of acromion may cause impingement and supraspinatus tear. Out of 70 patients it was seen in 22(31.4%) patients as shown in Table(15) and Figure(25)

Table 15: Patients with spur at anteroinferior aspect of acromion n=70

Spur	No. of cases	Percentage
absent	48	68.6%
present	22	31.4%
Total	70	100.0%

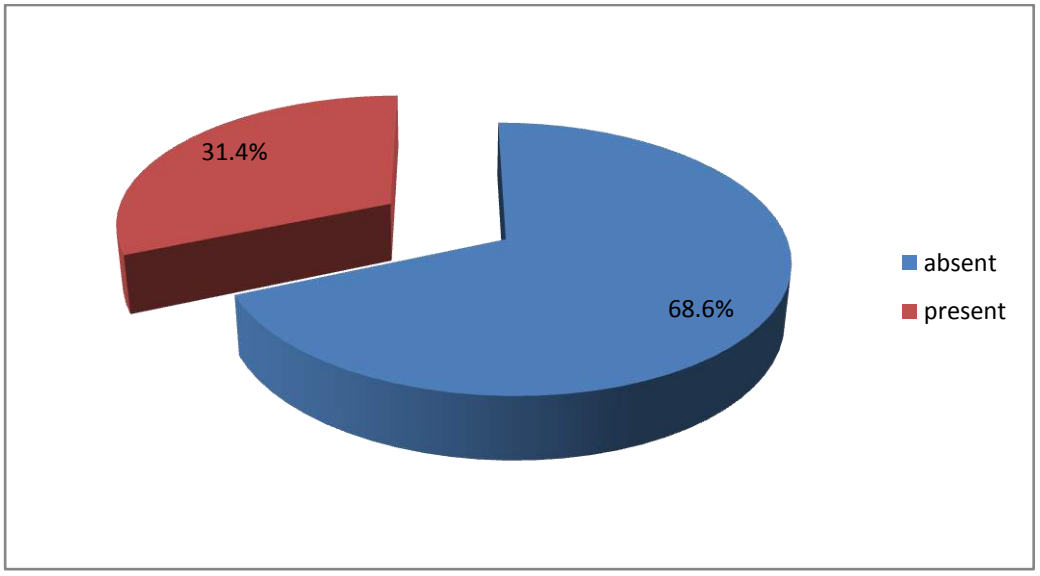

Figure 25: Pie chart patients with spur at anteroinferior aspect of acromion

Lateral angulation of acromion may also be responsible for impingement and out of 70 patients in the study it was seen in 26(37.1%) patients as shown in Table(16) and Figure(26)

Table 16 : Patients with lateral downsloping of acromion n=70

Lateral downsloping	No. of cases	Percentage
absent	44	62.9%
present	26	37.1%
Total	70	100.0%

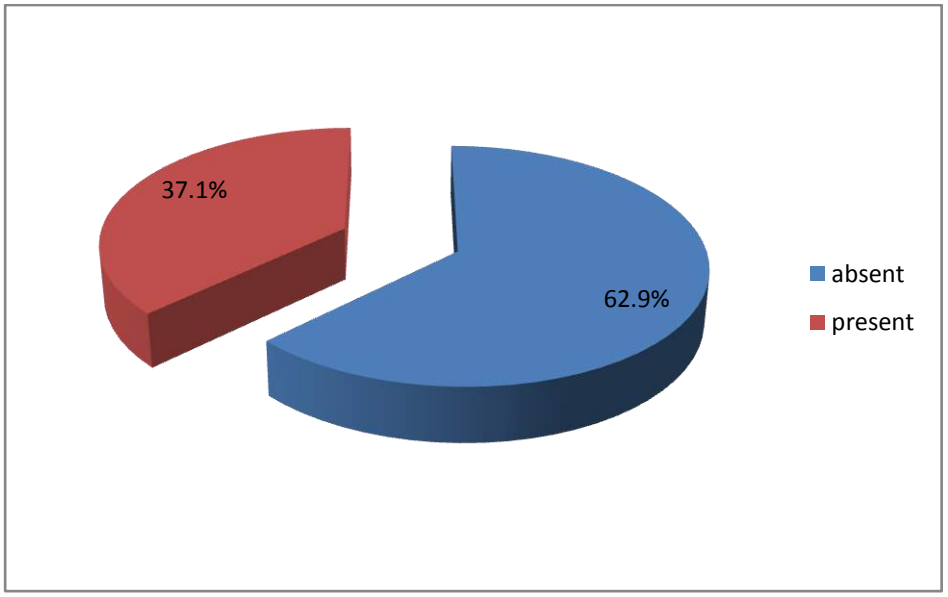

Figure 26: Pie chart of patients with lateral downsloping of acromion

(IV) SPECTRUM OF LABRAL PATHOLOGIES

Labral variants are seen in patients normally which can mimic labral tears and need to be identified on imaging to avoid unnecessary surgery . 4 major labral variants were noted . Out of 70 patients these variants were seen in 15 patients , out of which 7 had labral foramen, 6 had labral recess, Buford complex was seen in 1 patient as shown in Table(17) and Figure(27)

Table 17: Distribution of various labral variants n=70

Labrum variant	No. of cases	Percentage
none	56	80.0%
Buford complex	1	1.4%
sublabral recess	6	8.6%
sublabral foramen	7	10.0%
Total	70	100.0%

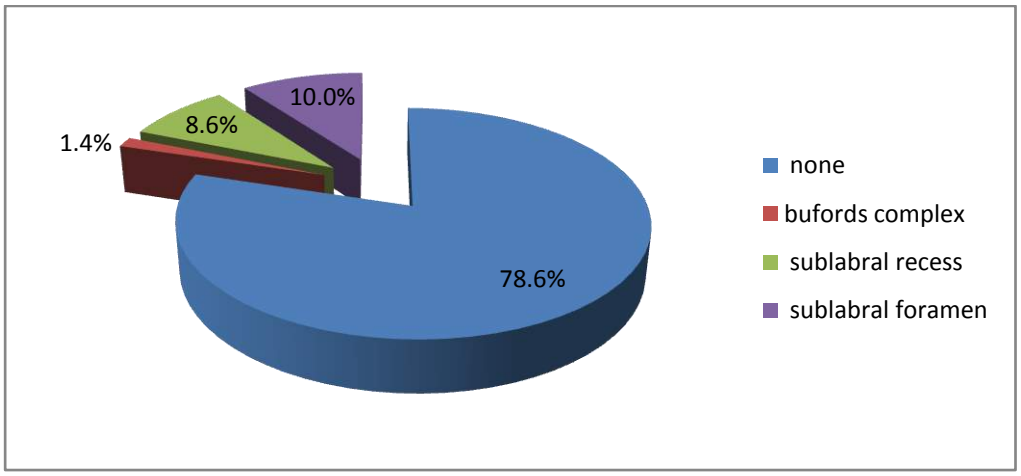

Figure 27: Pie chart of distribution of various labral variants

The patients involved in the study who had labral degeneration were divided in to 3 groups. Out of 70 patients of shoulder pain 14 patients had superior labral degeneration, 7 patients had anterior labral degeneration and 3 patients had posterior labral degeneration.

Out of 70 patients 28 patients had labral tears. Some patients had combined tears, therefore the overall tears were more than 28. Out of 70 patients in the study 12 patients had antero- superior labral tear, 13 patients had anteroinferior labral tears, 6 patients had posterosuperior labral tears, 6 patients had posteroinferior labral tears and 6 had Superior labral anteroposterior tears as shown in Table (18) and Figure(28)

Table 18: Distribution of patients with different types of labral tears

LABRAL TEARS	No. of cases	Percentage
antero superior	12	17.1%
antero inferior	13	18.6%
posterosuperior	6	8.6%
posteroinferior	6	8.6%
Type 2 SLAP	6	8.6%

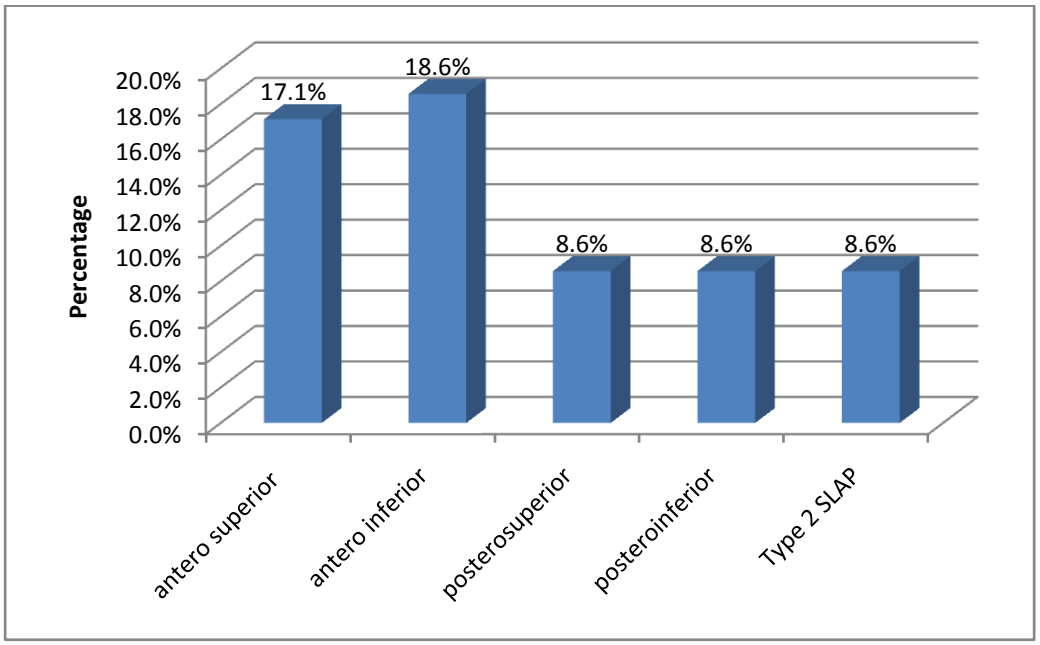

Figure 28: Bar graph of distribution of patients with different types of labral tears

Out of 28 patients with labral tears, bankarts lesion was seen in 12 patients and reverse bankart was seen in 4 patients as shown in Table (19) and Figure(29)

Table 19: Patients with bankart and reverse bankarts lesion n=28

	No. of cases	Percentage
Bankart lesion	12	42.8%
Reverse bankart lesion	4	14.2%

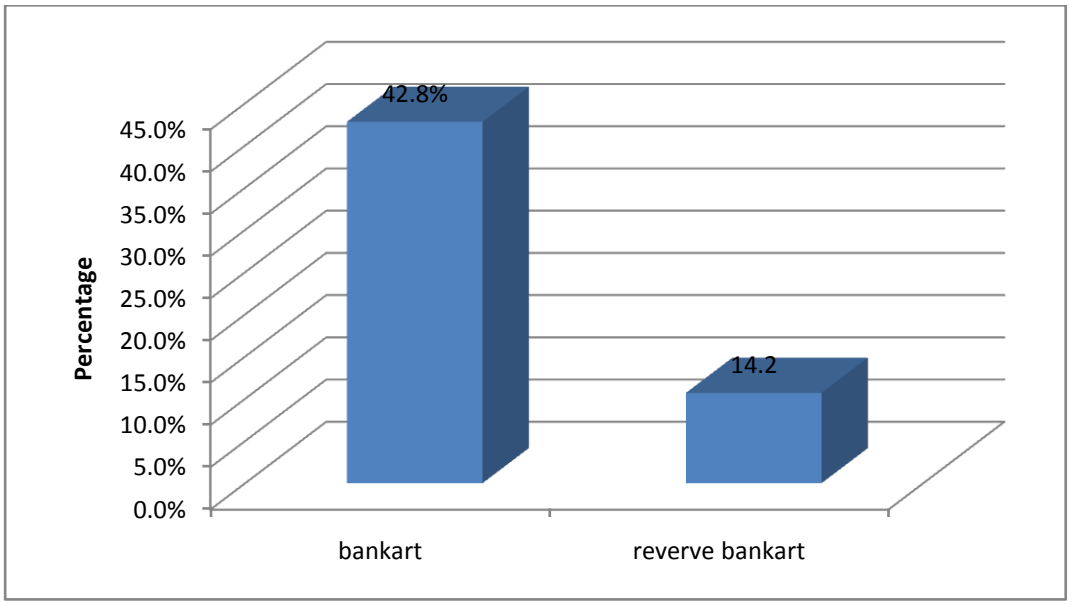

Figure 29: Bar graph of patients with bankart and reverse bankarts lesion

Out of 12 patients of bankart 7 had soft bankarts and 5 patients had bony bankarts lesion as shown in Table(20) and Figure(30)

Table 20: Distribution of patients with bankarts lesion n =12

	No. of cases	Percentage
soft bankart	7	58.3%
bony bankart	5	41.6%

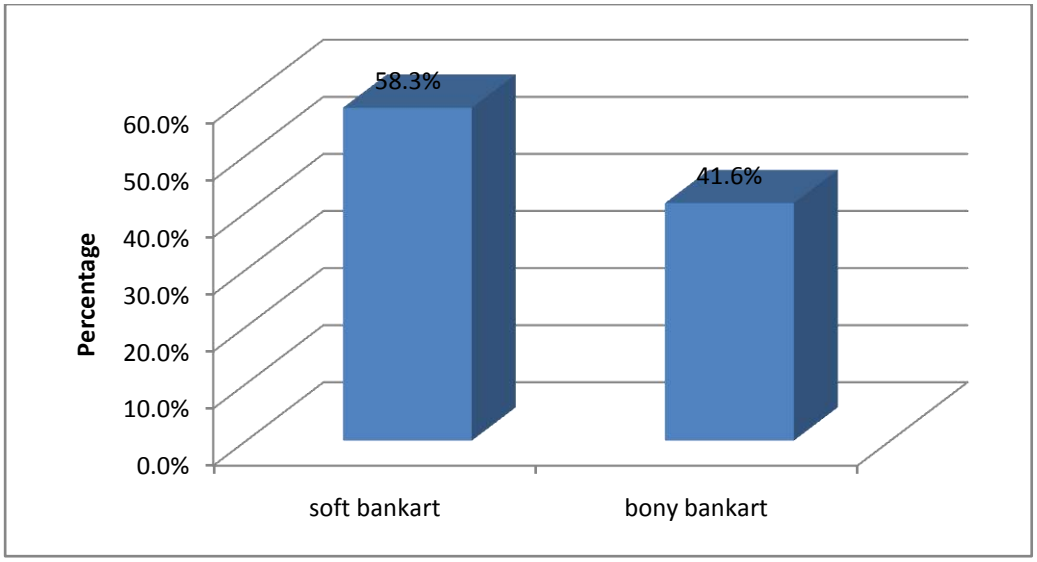

Figure 30: Bar graph of distribution of patients with bankarts lesion

Out of total 15 cases of bankart and reverse bankarts , periosteal stripping was seen in 13 cases as shown in Table(21) and Figure (31)

Table 21: Patients with periosteal stripping n=15

Periosteal stripping	No. of cases	Percentage
none	2	13.3%
present	13	86.7%
Total	15	100.0%

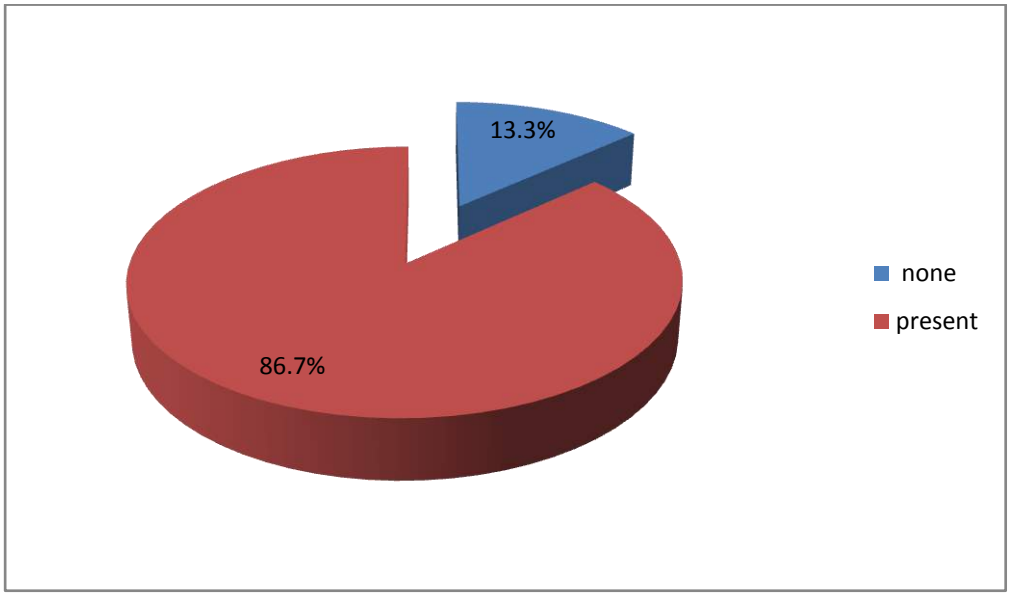

Figure 31: Pie chart of patients with periosteal stripping

The percentage of bone loss was calculated and divided into 6 groups as shown in Table(22) and Figure(32)

Table 22: Distribution of patients with percentage of bony loss n =13

Percentage of bony loss	No. of cases	Percentage
0-5	1	7.6%
06--10	3	23.0%
11--15	1	7.6%
16--20	1	7.6%
21--25	6	46.1%
>25	1	7.6%

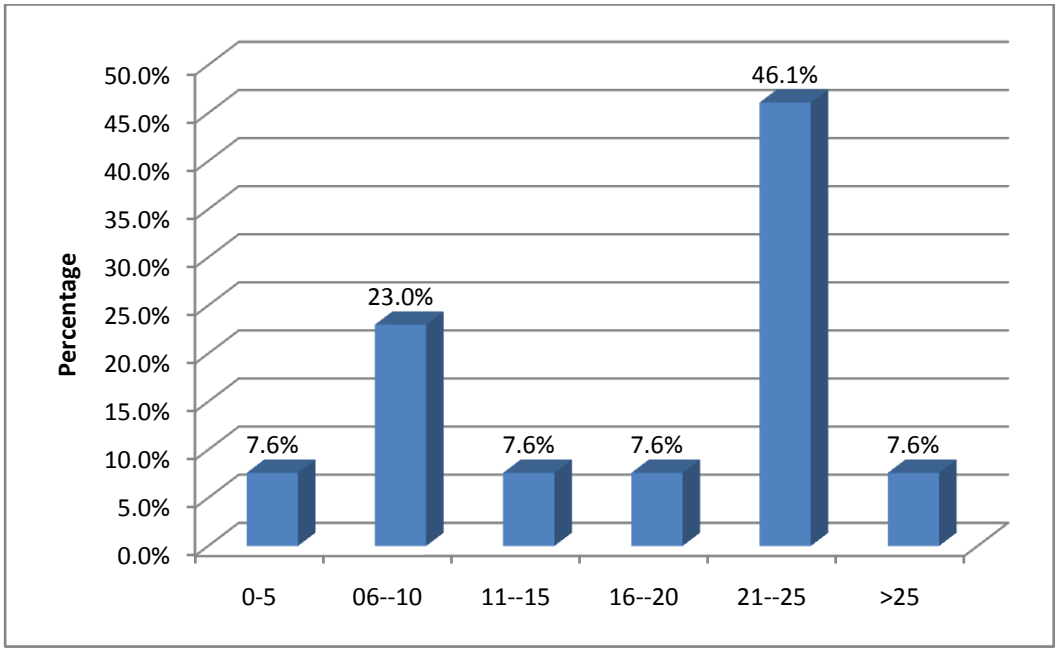

Figure 32: Bar chart showing distribution of patients with percentage of bony loss

Out of total 15 patients of bankart and reverse bankarts, hill sachs/ reverse hill sachs lesion was seen in 11 patients.

Among these 11 patients, hill sachs was seen in 10 patients and 1 patient had reverse hill sachs lesion as shown in Table(23) and Figure(33)

Table 23: Distribution of patients of bankarts with hill sachs lesion n=15

Hill Sachs	No. of cases	Percentage
no	4	26.6%
present	10	66.6%
reverse	1	6.6%
Total	15	100.0%

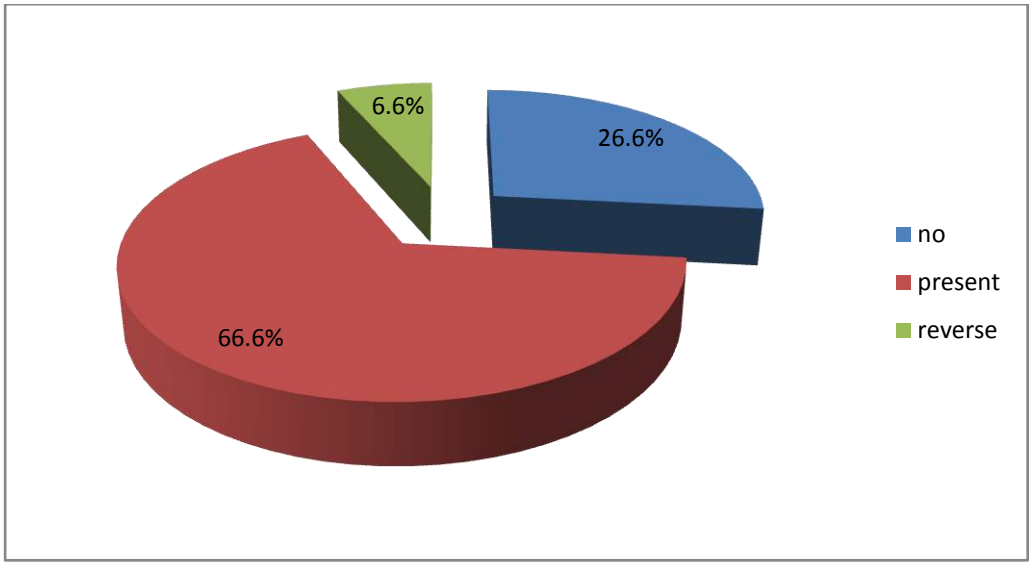

Figure 33: Pie chart of distribution of patients of bankarts with hill sachs lesion

Paralabral cysts were seen in 2 patients out of total 28 patients of tear as shown in Table (24).

Table 24: Patients with paralabral cysts n=28

Paralabral cyst	No. of cases	Percentage
absent	26	92.9%
present	2	7.1%
Total	28	100.0%

Out of total 70 patients, 8 were operated. The intra-operative findings in those patients are described in Table(25).

Table 25: Details of intra-operative findings

Serial no.	MRI findings	Intra-op findings
1	Type 3 Slap tear	Bucket handle tear of superior labrum with no extension into long head of biceps tendon
2	Hill sachs lesion with torn anteroinferior labrum. Small intrasubstance tear of subscapularis	Tear of anterior labrum predominantly in inferior quadrant with degeneration in superior labrum
3	Full thickness complete tear involving supraspinatus tendon at its insertion on greater tuberosity	Full thickness tear of supraspinatus which was repaired and subacromial decompression was done
4	Soft bankart with hill sachs lesion	Tear of anterior labrum
5	Near complete full thickness supraspinatus tear	Full thickness tear of supraspinatus
6	Locked posterior shoulder dislocation with posterior labral tear	Tear of posterior labrum
7	Hill sachs lesion with bony bankart with disruption of anteroinferior labrum	Tear of antero-inferior labrum with bony loss
8	Hill sachs with bankarts lesion and macerated labrum from 2-6 o clock position	Antero-inferior labral tear with degeneration of antero-superior labrum

DISCUSSION

Magnetic resonance imaging, with the advent of higher tesla MRI machines and surface coils has become a valuable approach in demonstrating the shoulder abnormalities. Imaging of the shoulder using MRI has various advantages over conventional techniques. The soft tissue structures of the shoulder are imaged in multiple planes, giving better spatial resolution. The rotator cuff is well visualized by magnetic resonance imaging and the individual tendons of the four rotator cuff muscles can be separately identified. MRI can demonstrate the rotator cuff excellently including the subacromial portion, which is hidden from view on ultrasonography. Similarly labrum and the glenohumeral ligaments can be well visualized, helping us to identify various tears and normal labral variants.

In this study 70 patients with rotator cuff disorders and glenohumeral pathologies were included and magnetic resonance imaging characteristics of the abnormalities were described. Age and gender distribution among the study population were also described. All the imaging was done using a 3.0 Tesla machine in the department of Radiodiagnosis, Dayanand Medical College and Hospital Ludhiana.

In our study rotator cuff tears were more common than labral tear which were seen in 57% and 40% patients respectively. Bhatnagar et al[77] also found that out of 39 patients who presented with shoulder pain, Rotator cuff (RC) tear was the most common pathology. Yamamoto et al [80] also found that Rotator cuff tears were present in 20.7% of general population with shoulder pain and the prevalence increased with age. 36% of the subjects with current symptoms had rotator cuff tears, while 16.9% of the subjects without symptoms also had rotator cuff tears.

Age of the patients with rotator cuff disorders ranged from 17 to 77 years with the mean of 47-48 years. Majority of the patients were in older age group with the peak incidence was found in the fifth and the sixth decade of life. Various literatures have pointed out that the incidence of rotator cuff tendon degeneration and injury increases

with the age. Rotator cuff diseases are multi factorial with both extrinsic and intrinsic factors responsible. Ozaki et al. believed that the underlying mechanism of rotator cuff disorders is an intrinsic process and the risk of various rotator cuff disorder increases with age.[81] In a study conducted by Needell et al [82] in 100 asymptomatic shoulders, a higher incidence of tears was seen in the older age group in the fifth and sixth decade of life. Yamamoto et al [80] also found the mean age to be in older population and was 58 years.

In our study in case of rotator cuff tears, out of 40 patients 52% were male and 48% female patients, thus showing no significant difference in the gender distribution among the study population This is correlated with a study done among 90 patients by Milgrom et al [83], which showed no statistically significant differences in the incidence of rotator-cuff lesions related to gender.

In our study, full thickness rotator cuff tears were more than partial tears. However most studies found partial thickness tears to be more prevalent than full thickness rotator cuff tears. In 1987 Yamanka et al[85] and Fukuda et al [34] reported a prevalence of 20% (7% FTT and 13% PTT) in a series of 249 cadavers. Amongst the PTT they found bursal-sided tears in 18%, intratendinous tears in 55% and articular sided tears in 27%. That same year Lohr and Uhthoff [85] found 19% FTT and 32% for PTT amongst 306 cadavers. Conversely in 1995 Lehman et al[86] reported a total prevalence of 17% of FTT amongst 235 cadavers (6% < 60 year olds and 30% > 60 years old). In 2006 a literature review of cadaveric studies by Reilly et al [87] found the total prevalence of RCT was 30.24% (11.75% FTT and 18.49% PTT) amongst 2553 cadaveric shoulders. This difference could be explained by the fact that most of patients are referred from periphery to our tertiary care institute.

Among the rotator cuff tendons the most commonly affected tendon is supraspinatus followed by subscapularis and infraspinatus. Teres minor was not involved in any of the patients in our study. These findings were mostly consistent with the current literature. Jerosch et al[88] conducted a study on the dissected specimen of shoulder joints

of 122 patients and they found that isolated supraspinatus occurred in 78% cases. In our study, there were total 15 patients of partial supraspinatus tear, out of these 10(66.7%) had articular surface tear, 2(13.3%) had intrasubstance tear and 3(20%) had bursal surface rotator cuff tears . No patient in our study had teres minor tear. Literature also points that teres minor tears are rare, even in combination with other rotator cuff tendon tears. In a study done by Melis et al [89], they showed that in the 1572 rotator cuff tears they reviewed, the teres minor was normal in 90.8% of shoulders, hypertrophic in 5.8%, atrophic in 3.2%, and absent in 0.2%.

Out of patients with supraspinatus tears partial supraspinatus tear were seen in 41.9% patients while 57.1% patients had full thickness rotator cuff tear.

In our study , most common type of acromion was type 2 seen in 81.4 % of patients, followed by type 1 in 11.4%. Type 3 and 4 were less common and were seen in 2.9% and 4.3% cases. The results are consistent with Rania e Mohamed et al[90] who also found that among 56 patients type 2 acromion was most common seen in 45 % patients. Thawanthorn Chaimongkhol et al[91] also found that the curved acromion had the highest prevalence in total population. Its prevalence was 78.8%. The second highest was hooked acromion for 12.0%, and the last was flat acromion for 9.2%

In our study out of 70 patients labral variants were seen in 14(20.0%) patients. Most common variant seen was sublabral foramen seen in 7 patients, which was followed by sublabral recess and bufords complex which was seen in 6 and 1 patients respectively. It was in correlation with study conducted by anita g et al[92] in 546 pts labral variants were seen in 73 pts (13.4%). Among them sublabral foramen was most common seen in 47 patients, sublabral recess was seen in 18 patients and bufords complex (which was least common) was seen in 8 pts. Ulunay Kanatli et al[93] also evaluated 713 patients and found that labral variants were seen in 98 patients (14.18%), the anatomic variations in the anterosuperior labrum were classified into 3 groups as the sublabral recess (2.46%), the sublabral foramen (7.67%), and absent

anterosuperior labrum with a cord-like middle glenohumeral ligament (4.05%)

Out of 70 patients 40% patients had labral tears. Some patients had combined tears, therefore the overall tear number was more than 28. Out of 70 patients in the study 17.1% patients had antero- superior labral tear, 18.5% patients had anteroinferior labral tears, 8.5% patients had posterosuperior labral tears, 8.5% patients had posteroinferior labral teats and 8.5% had SLAP tears.

There was no radiological literature found which divided and described the labral tears according to clock positions / quadrants of labrum.

Similar to the vastly prevalent literature our study also showed that the anterior dislocation was more common than posterior dislocation. In a study done by Oreste Lemos Carrazzone[94] et al in 73 patients with shoulder dislocations he found that bankarts was seen in approx 78% patients and SLAP lesion was seen in approx 30 percent patients. In our study among the patients of bankarts lesion soft bankart/ cartilaginous bankart was more common and was seen in approximately 60% of patients . This was consistent with study done by k horse et al[95] in which out of 80 patients with bankarts lesion was seen in 71% patients. Out of total 12 patients with bankarts lesion , hill sachs was seen in 83% patients. This was also similar to study done by K Horse et al[95] who found that co occurrence of these lesions was 11 times more common than presence of any 1 lesion.

In our study out of all patients only 8 patients were operated. This low incidence in surgery could be attributed to various factors, like age of the patient, general health of the patient and the tendency to avoid surgery at all cost. Most patient who were operated were young, and 6 of these 8 patients were aged 48 years or less. Only 2 patient above 50 years got operated, even when the major bulk of patients in the study group were in the older age group .None of the partial rotator cuff tear patients were operated. Even in united states a study conducted by chapman et al[96] found that among patients who were identified as having a new, symptomatic, MRI-confirmed atraumatic rotator cuff tear (n = 32,203), 19.8% were managed with initial surgery; 41.3%, with

initial physical therapy; and 38.8%, with watchful waiting. Patients who were older, had more comorbidities , or were female, of non-white race, or dual-eligible for Medicaid were less likely to receive surgery. Denkers et al[97] reviewed 76 consecutive patients with PTRCTs in which 50% were treated non-operatively. At a mean of approximately 4 years of follow-up, 91% of patients were still satisfied with non-operative treatment. Patients who had an atraumatic onset of symptoms involving the nondominant extremity, as well as a tear that involved < 50% of the tendon thickness, were more likely to be treated nonoperatively. A review of cadaver and radiologic studies revealed a prevalence of rotator cuff tears of at least 10% in people over the age of 60 in the United States.[86] Numbers of rotator cuff surgeries performed per year in the United States are estimated between 75,000 to 250,000 patients.[98] These numbers indicate that actually less than 5% of patients in the United States with rotator cuff tears are treated surgically.

Amongst the patients that were operated, the intra-operative findings correlated with those given in MRI. This was in correlation with studies done by Gururaj et al in 2017[78] and Yogesh Sharma et al in 2019.[79] Thus we have good enough evidence that 3T MRI is non –invasive investigation of choice for evaluation of rotator cuff pathologies and glenohumeral instability as it has good correlation with clinical and arthroscopic findings as discussed previously by Thomas H Magee et al in 2006[66] and Liu F et al in 2020.[99]

SUMMARY AND CONCLUSION

1. The present study was conducted at the Department of Radiodiagnosis, Dayanand Medical College and Hospital, Ludhiana
2. Seventy patients who were clinically suspected to have rotator cuff pathologies and glenohumeral instability were scanned on SIEMENS MAGNETOM SKYRA 48 CHANNEL 3 Tesla MRI. The sequences used in the study were proton density and T1 weighted fast spin echo in axial plane , proton density, T2 weighted fast spin echo with and without fat suppression in coronal plane, T1 and PD fat sat sequences in sagittal plane.
3. Age range of the patients in the study was 17-77 years with mean of 47-48 years.
4. Rotator cuff tears were more common than labral tears which were seen in 57% and 40% patients respectively.
5. Most common age group in rotator cuff tears was 61-70 years.
6. Most common tendon involved in rotator cuff tear was supraspinatus which was involved in 47% of the patients in the study. No tear was seen in teres minor tendon.
7. Full thickness supraspinatus tears were more common than partial thickness tears
8. Articular surface partial tears were the most common type of partial rotator cuff tears.
9. Type 2 acromion was the most common type of acromion seen in 81.4% of patients.
10. Acromion spur was seen in 31.4% patients and lateral downsloping was seen in 37.1% patients.
11. Labral variants were seen in 20% patients and sublabral foramen was the most common variant.
12. Anteroinferior quadrant was the most common involved quadrant in labral tears and was involved in 18.6% patients of the study group
13. Of the 28 patients with labral tears Bankart lesion was seen in 42.8 percent patients and reverse bankart lesion was seen in 14.2% patients.

14. 8 patients were operated and 6 of those patients had age of 48 years or less.
15. Amongst the patients who were operated, the intra-operative findings correlated with those given on MRI.

CONCLUSION

MRI is an excellent non invasive modality for evaluation of shoulder joint. A 3T MRI delivers twice the field strength of 1.5T MRI scanners, providing greater detail in both structure and function, and offering image clarity that is ideal for musculoskeletal imaging. The 3 tesla MRI provides excellent soft tissue contrast and also helps in detailed evaluation of bones and marrow pathologies without exposing the patients to ionizing radiation. The benefit of MRI is its ability to diagnose the rotator cuff and labral tear without subjecting a patient to an unnecessary MR arthrogram. The patient does not have to undergo an invasive procedure that may have some complications, which would include the potential of infection, bleeding, and discomfort from the procedure. The bottom line is that 3-tesla MR of the shoulder without arthrography can be sufficient for preoperative planning for various rotator cuff pathologies and glenohumeral instability.

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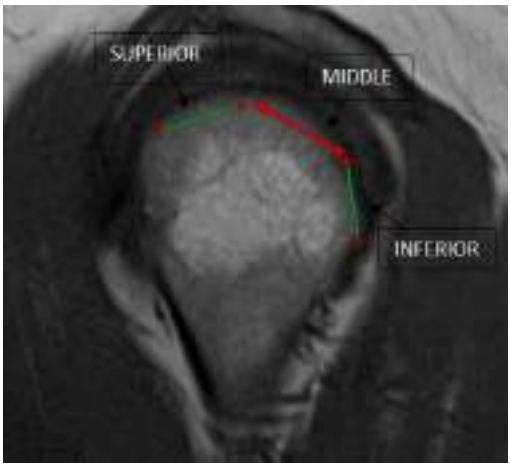
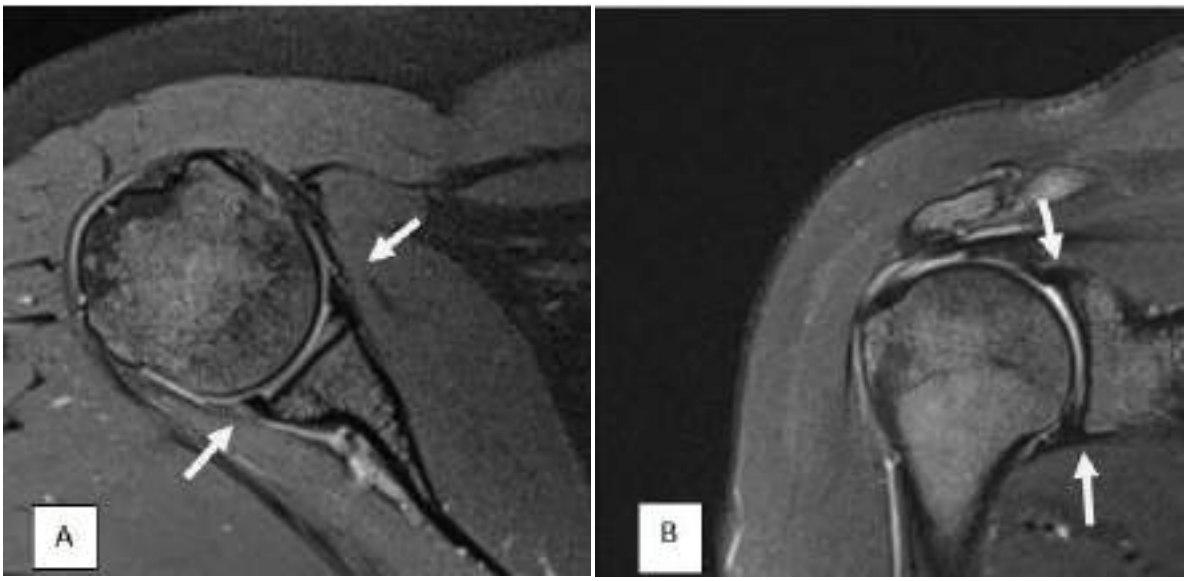
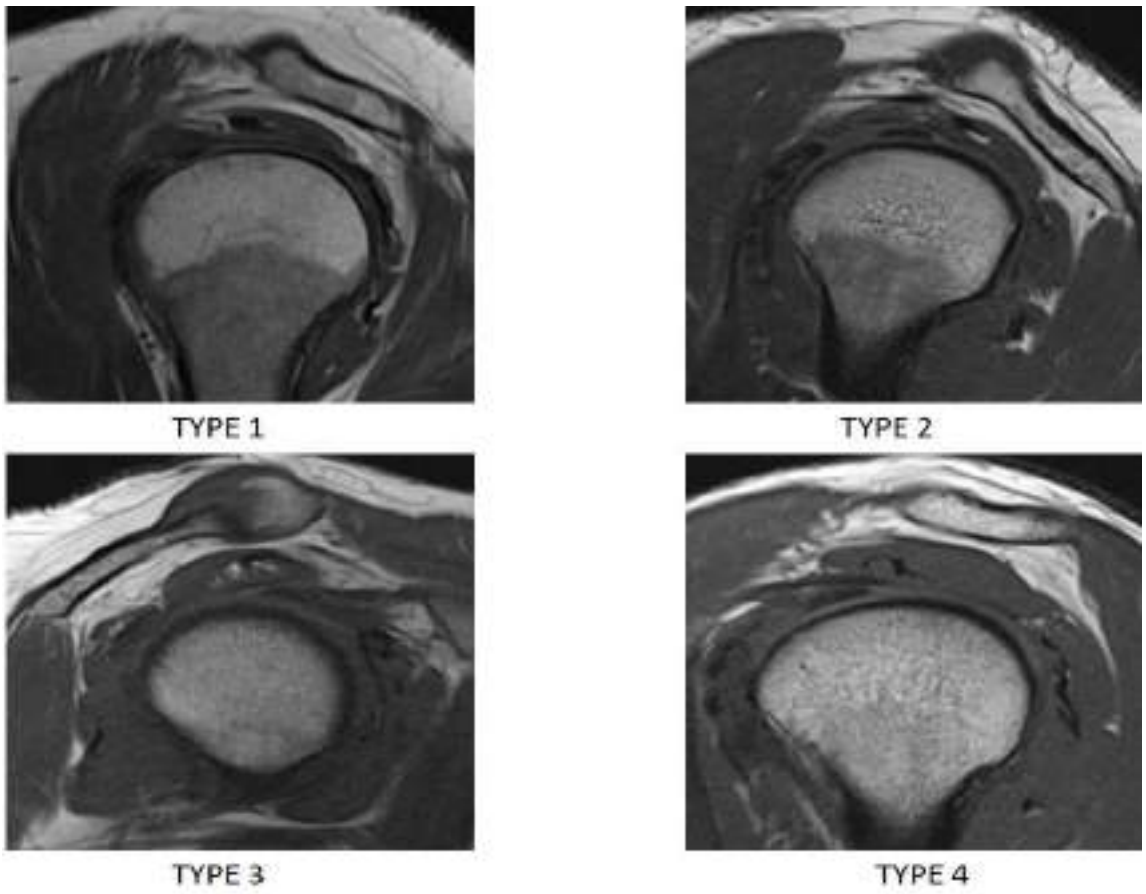


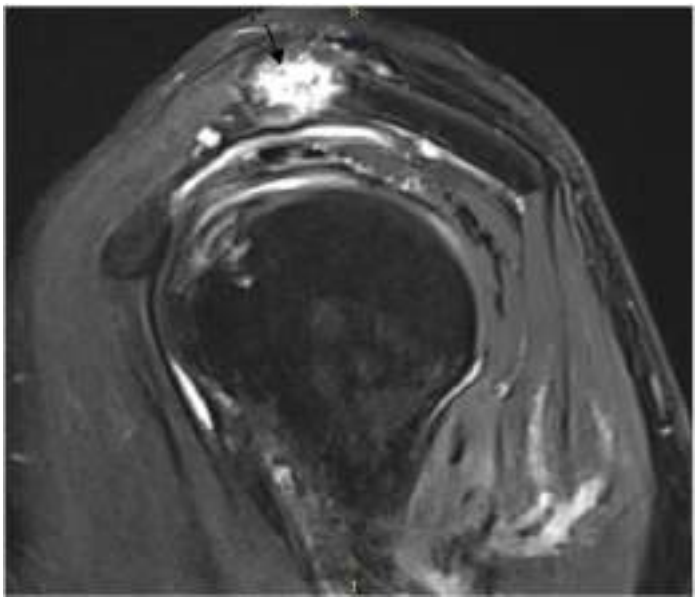
PICTURE 1: T1 SAGITTAL IMAGE SHOWING THE 3 FACETS ON GREATER TUBEROSITY OF HUMERUS



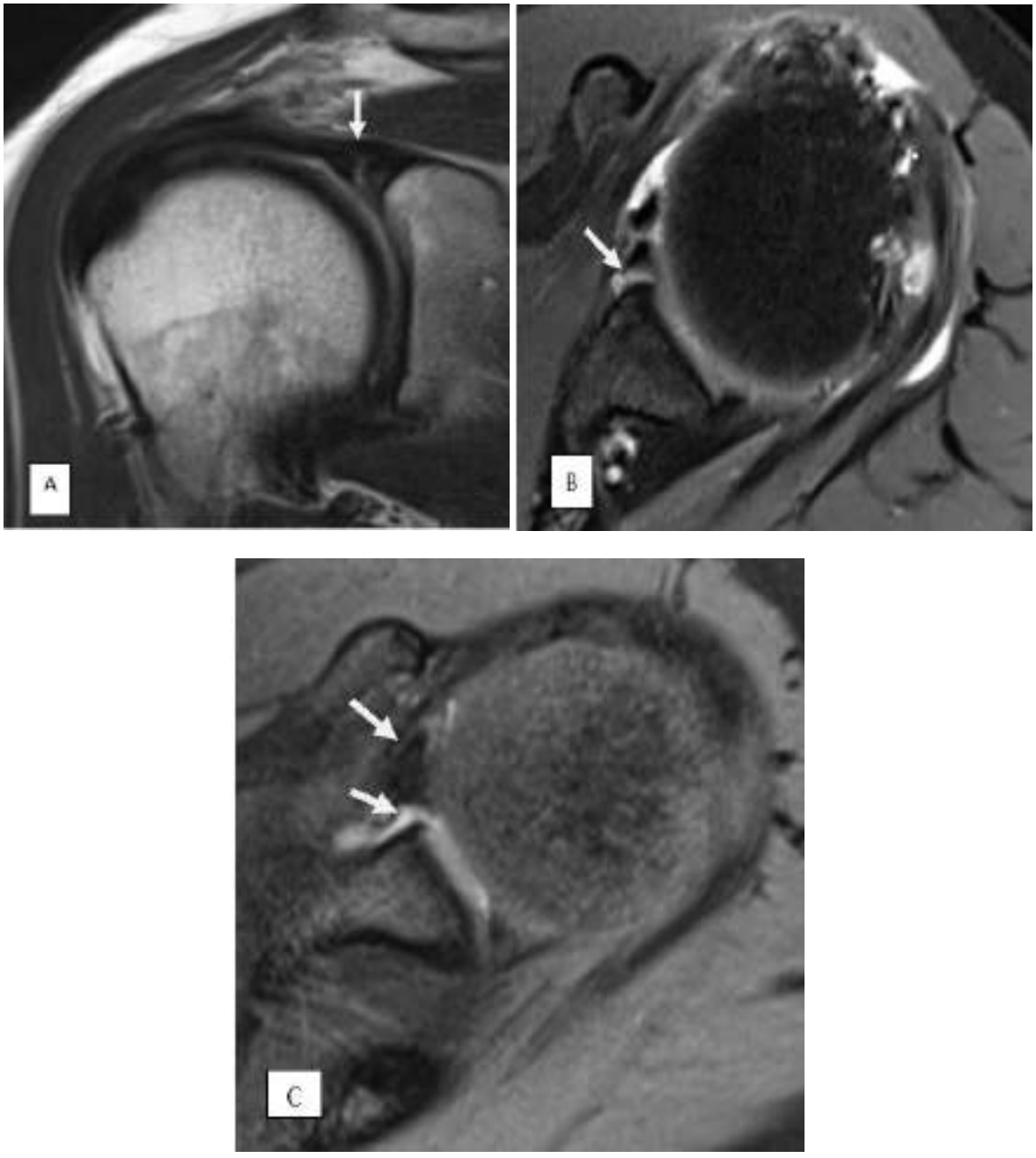
PICTURE 2: (A)CORONAL AND (B)AXIAL PD FAT SAT IMAGES SHOWING NORMAL LABRUM



PICTURE 3: SAGITTAL T1 IMAGES SHOWING DIFFERENT TYPES OF ACROMION

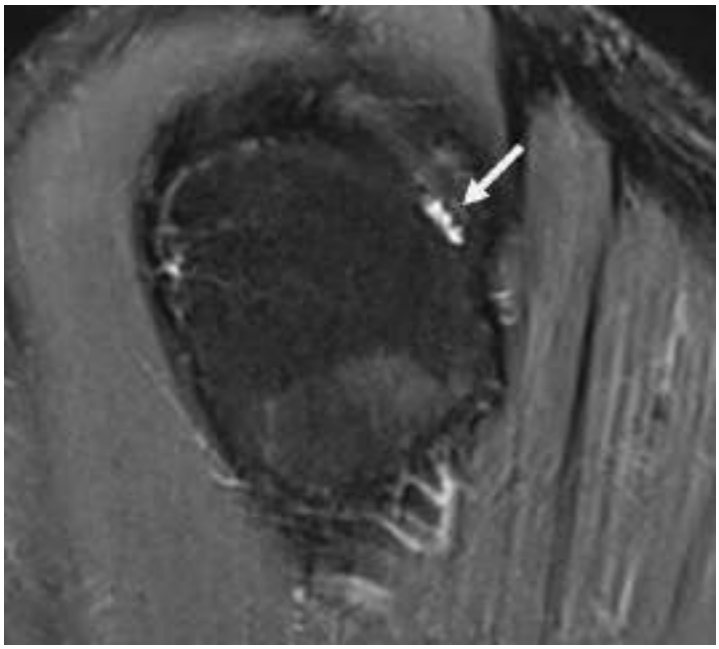


PICTURE 4: SAGITTAL PD FS IMAGES SHOWING ACROMIOCLAVICULAR JOINT DEGENERATION

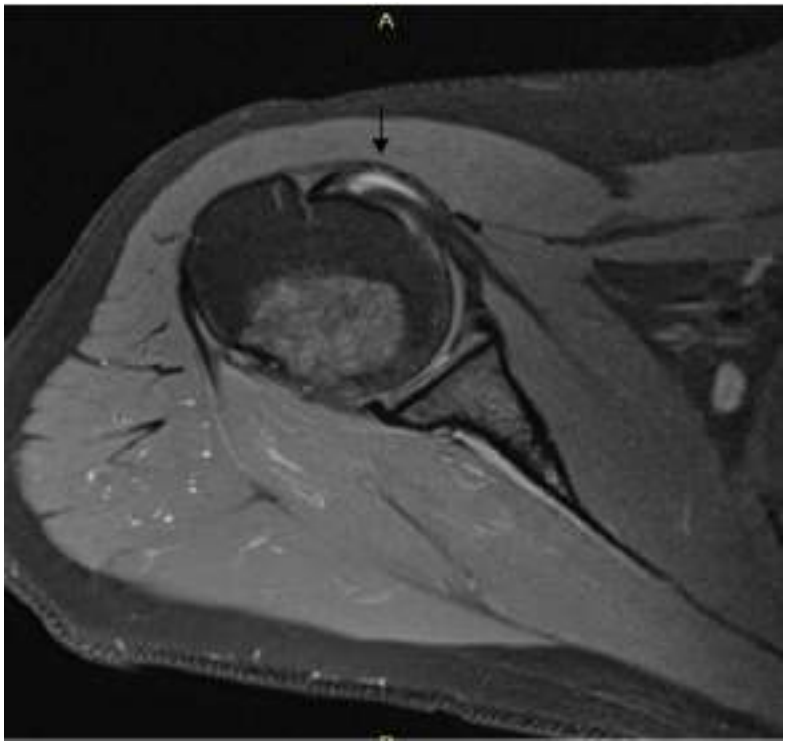


PICTURE: 5 LABRAL VARIANTS, A) PD FS CORONAL IMAGES SHOWING SUBLABRAL RECESS, B) T2 FS AXIAL IMAGES SHOWING SUBLABRAL FORAMEN, C) PD FS IMAGES SHOWING ABSENT ANTERIOR LABRUM WITH THICKENED MGHL S/O BUFORDS COMPLEX

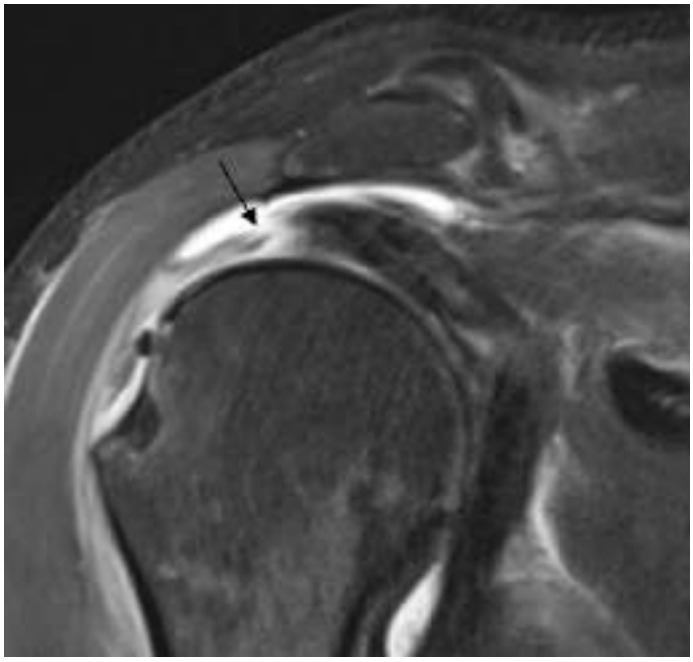
PICTURE 6: PARTIAL SUPRASPINATUS TEARS,A)CORONAL PD FAT SAT IMAGE SHOWING ARTICULAR SURFACE TEAR, B)CORONAL PD SAT IMAGE SHOWING BURSAL SURFACE TEAR, C) CORONAL PD FAT SAT IMAGE SHOWING INTRASUBSTANCE TEAR



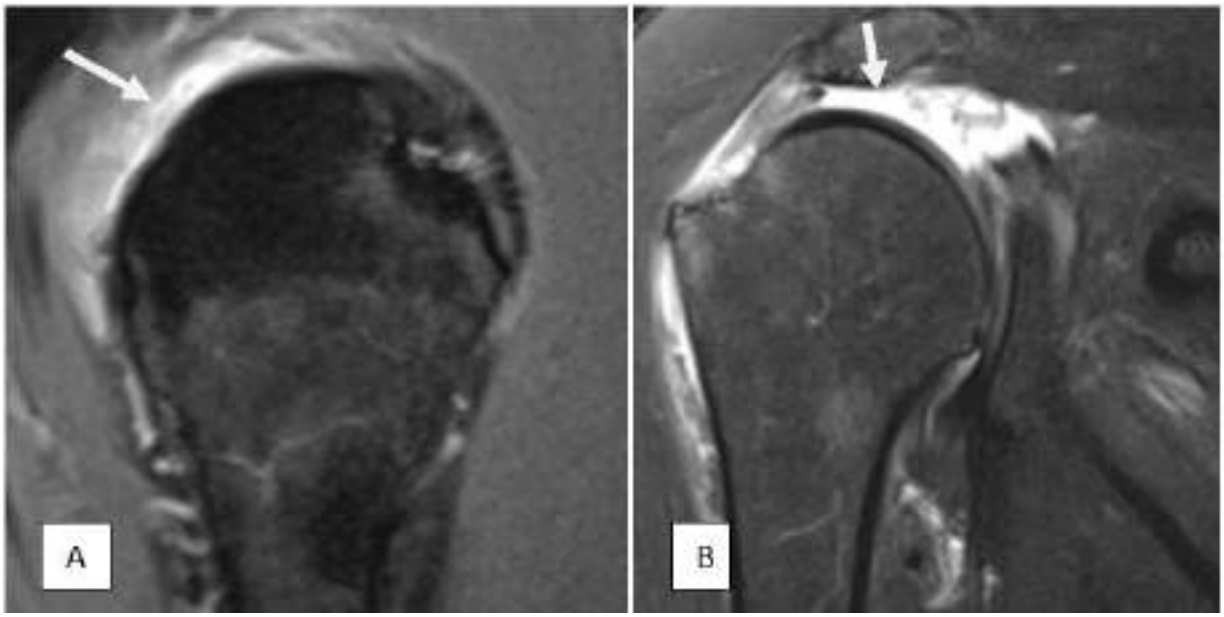
PICTURE 7: SAGITTAL PD FAT SAT IMAGE SHOWING PARTIAL INFRASPINATUS TEAR



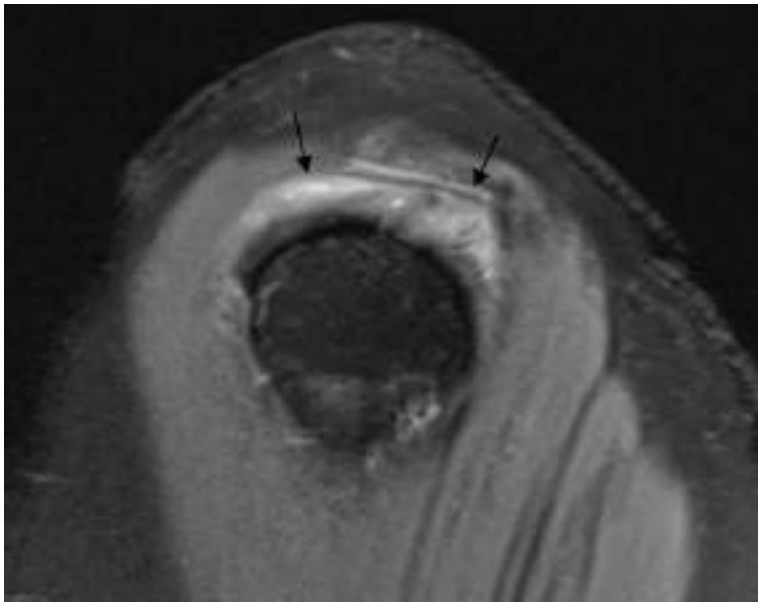
PICTURE 8: AXIAL PD FAT SAT IMAGE SHOWING INTRASUBSTANCE PARTIAL SUBSCAPULARIS TEAR



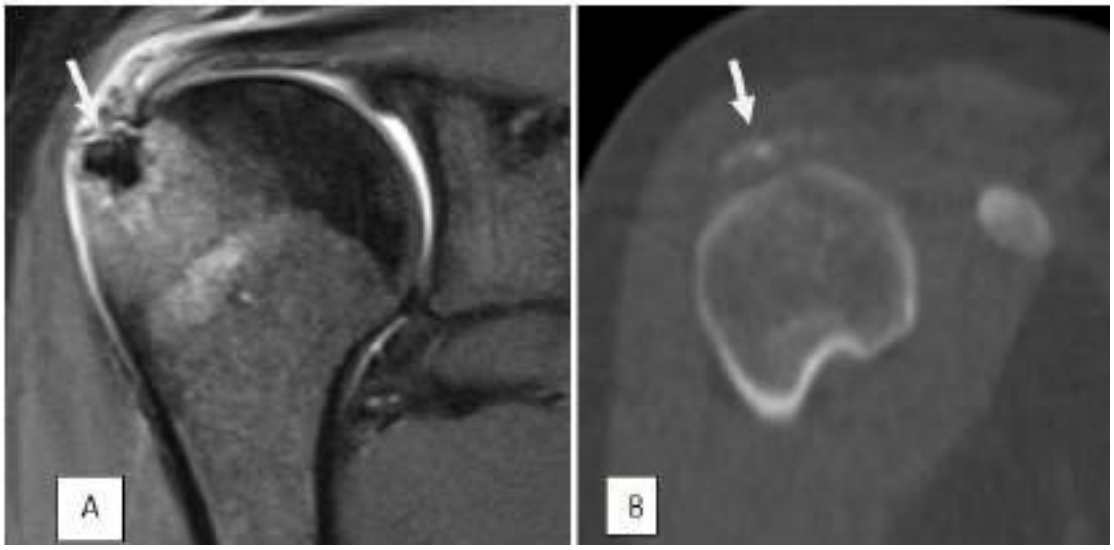
PICTURE 9: CORONAL PD FAT SAT IMAGE SHOWING FULL THICKNESS SUPRASPINTUS TEAR



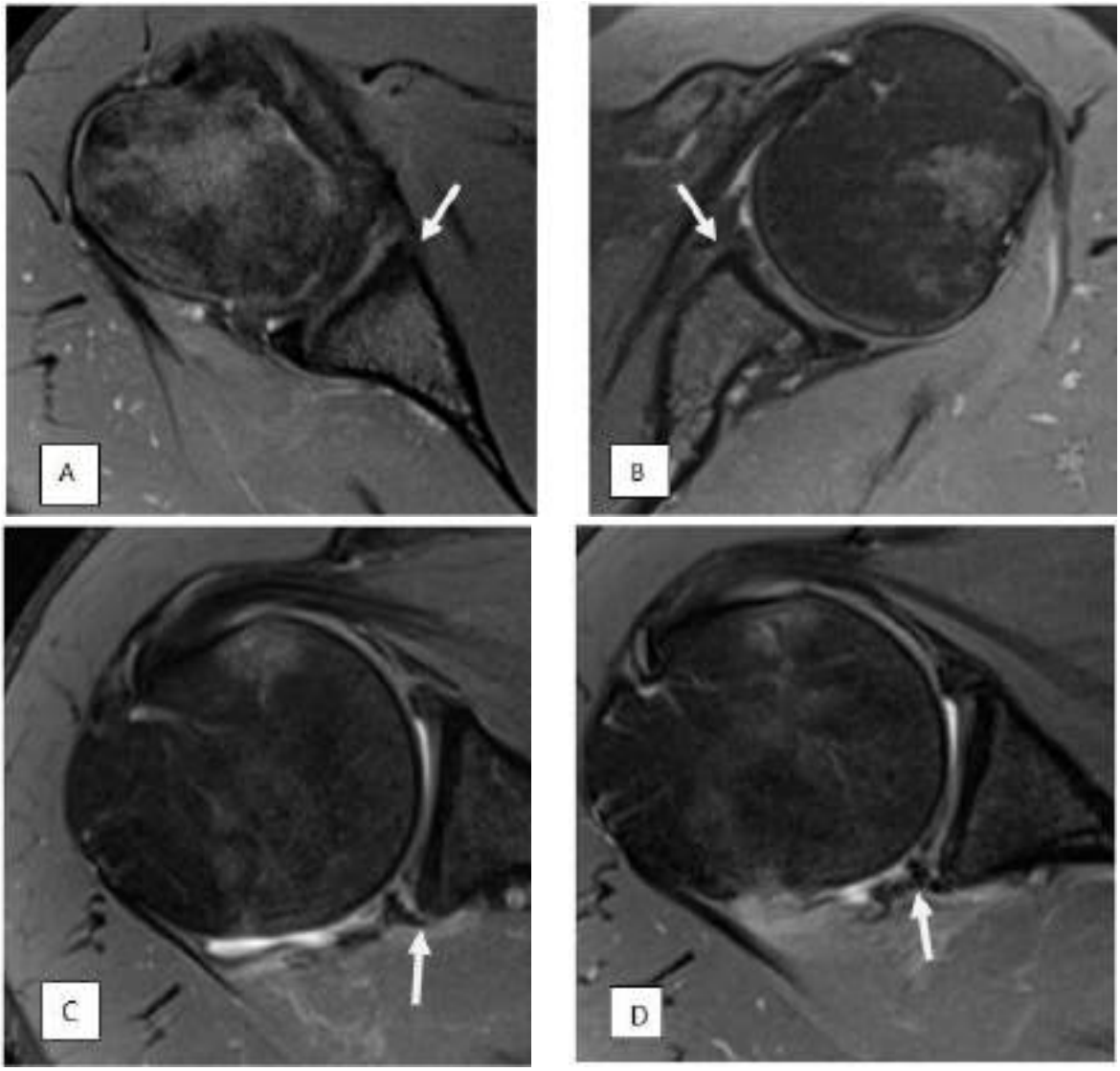
PICTURE 10: A)SAGITTAL , B) CORONAL PD FAT SAT IMAGES SHOWING FULL THICKNESS INFRASPINATUS TEAR



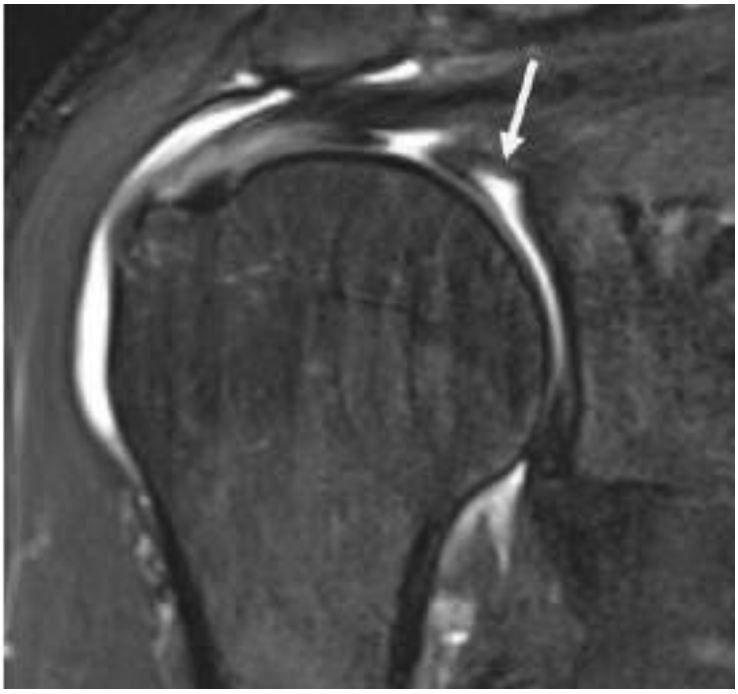
PICTURE 11: SAGITTAL PD FAT SAT IMAGE SHOWING SUPRASPINATUS AND INFRASPINATUS TENDINOSIS



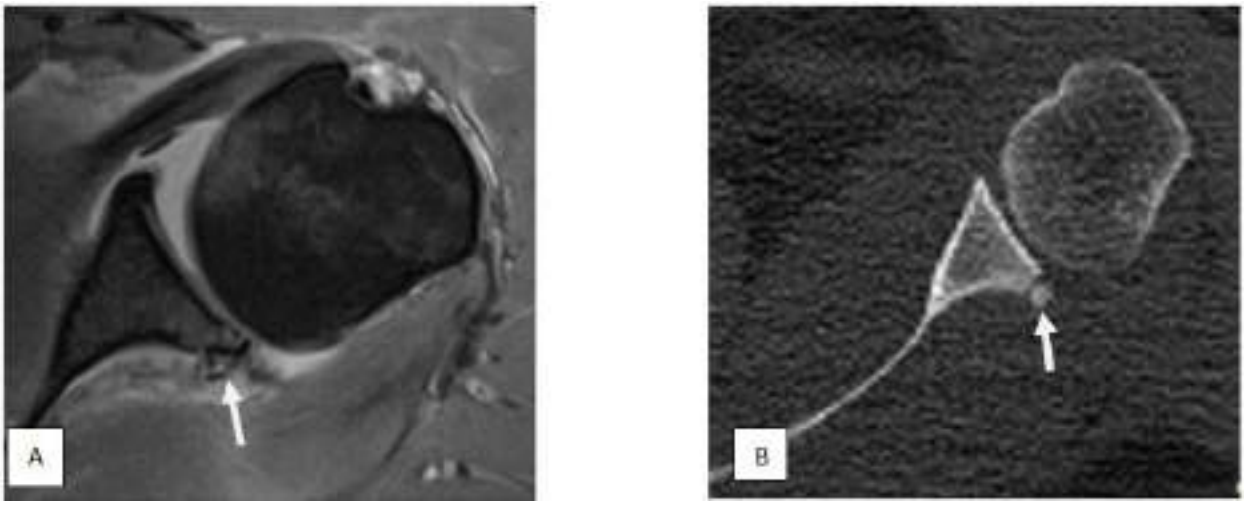
PICTURE 12: A) CORONAL T2 FAT SAT ,B) CORONAL CT IMAGES SHOWING CALCIFIC TENDINOSIS OF SUPRASPINATUS TENDON



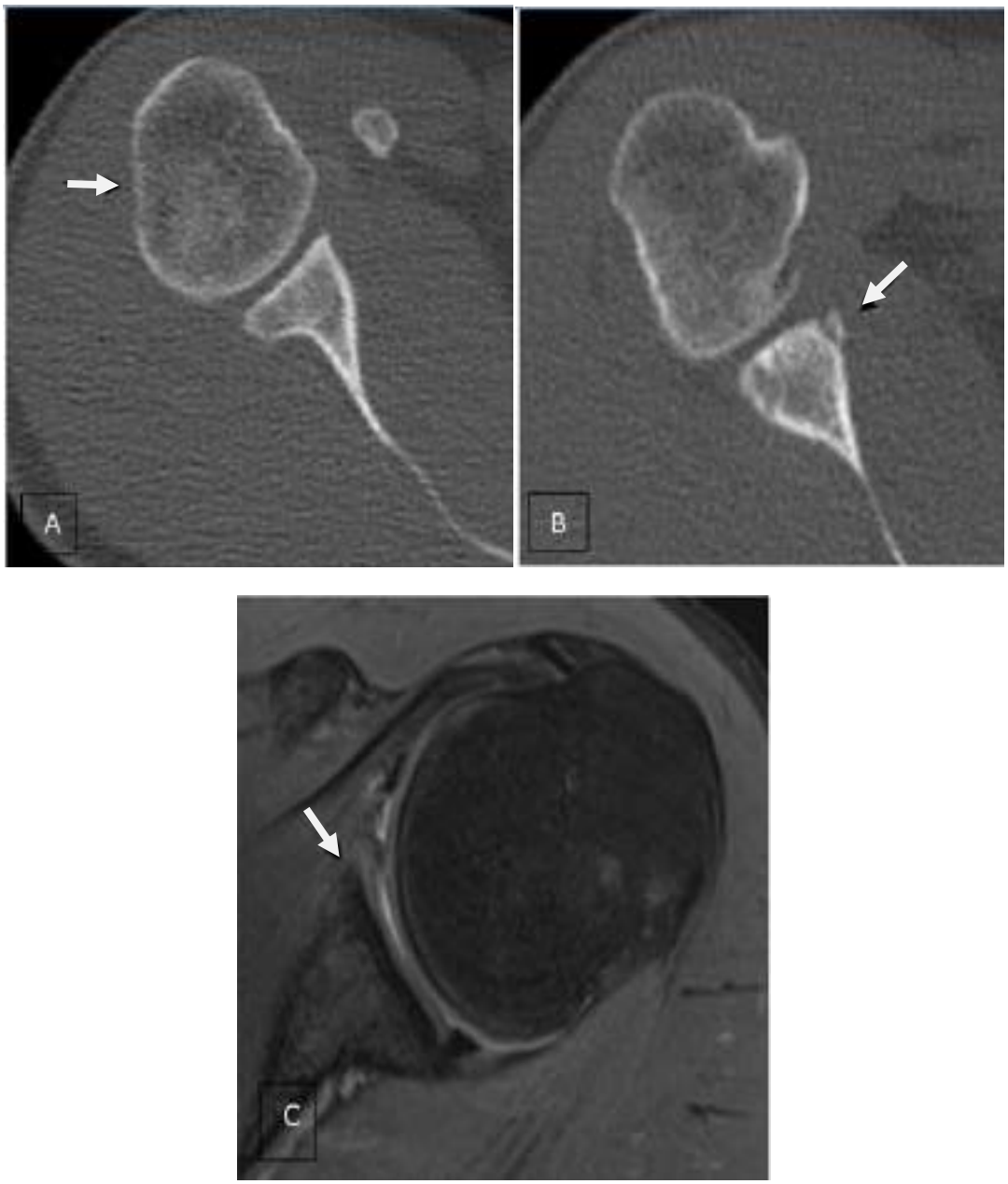
PICTURE 13: LABRAL TEARS , AXIAL PD FAT SAT IMAGES SHOWING A) ANTERO-INFERIOR LABRAL TEAR, B)ANTERO-SUPERIOR LABRAL TEAR,C)POSTERO-SUPERIOR LABRAL TEAR, D) POSTERO-INFERIOR LABRAL TEAR



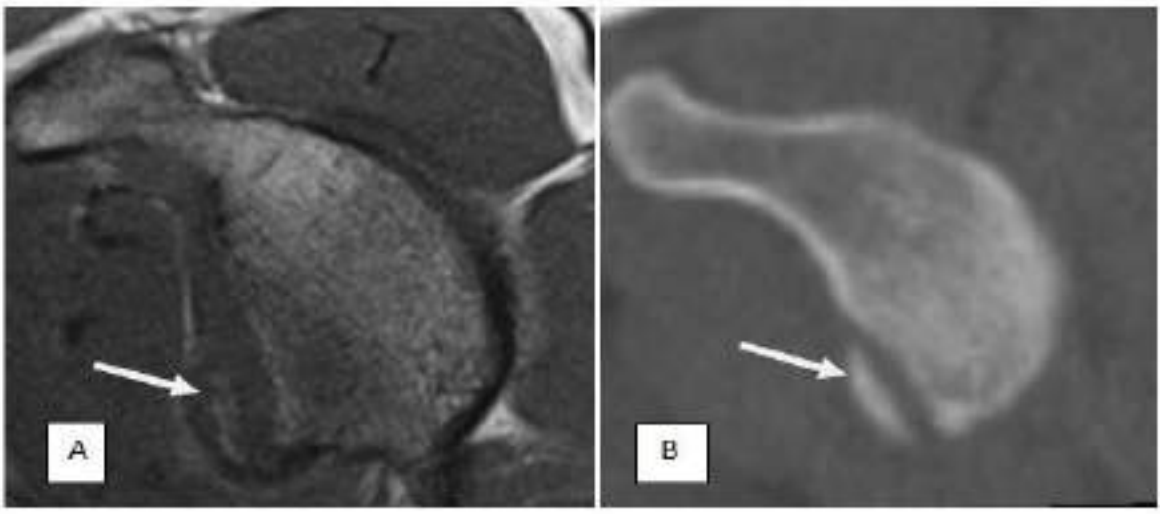
PICTURE 14: CORONAL PD FAT SAT IMAGE SHOWING SLAP TEAR



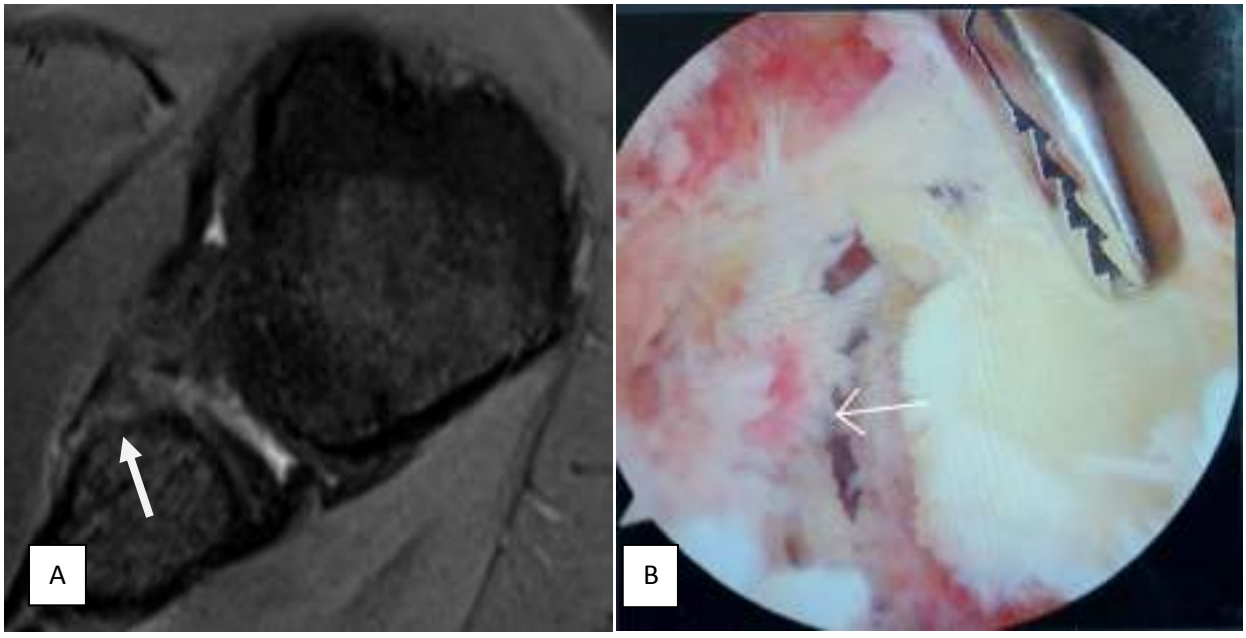
PICTURE 15: REVERSE BONY BANKART TEAR, A)AXIAL T2 FAT SAT IMAGE SHOWING POSTERO-INFERIOR LABRAL TEAR , B) AXIAL CT IMAGE SHOWING POSTERIOR GLEOID RIM FRACTURE



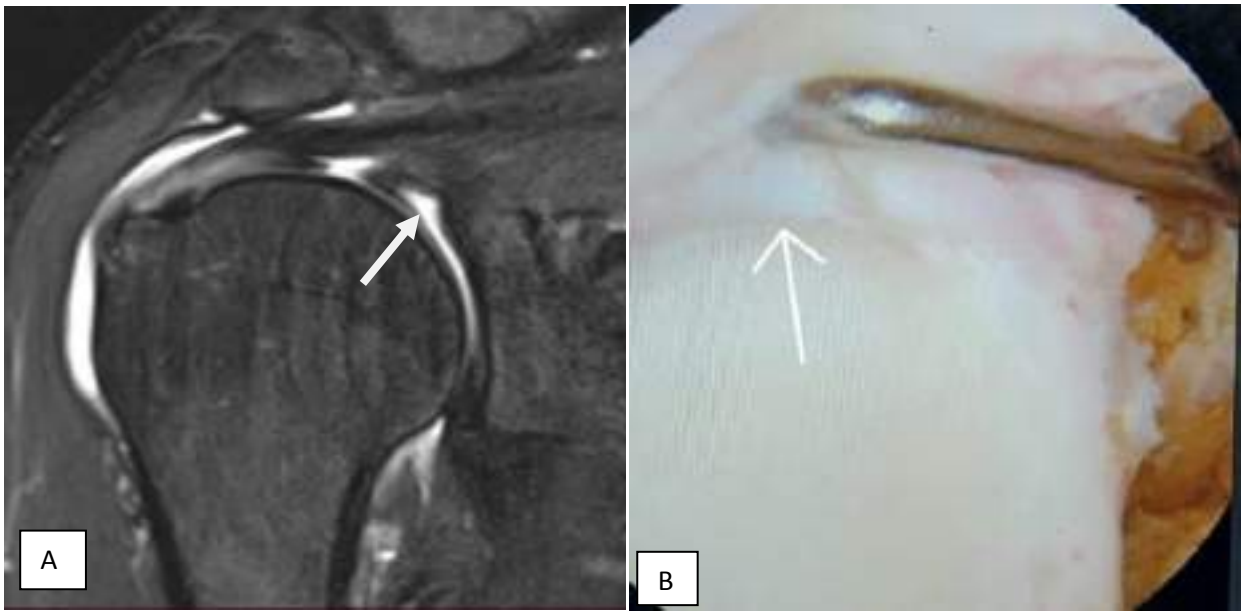
PICTURE 16: BONY BANKART TEAR, A) AXIAL CT IMAGE SHOWING HILL SACH LESION ON HUMERAL HEAD, B) AXIAL CT IMAGE SHOWING ANTERIOR GLENOID RIM FRATURE, C) AXIAL T2 FAT SAT IMAGE SHOWING ANTERO INFERIOR LABRAL TEAR



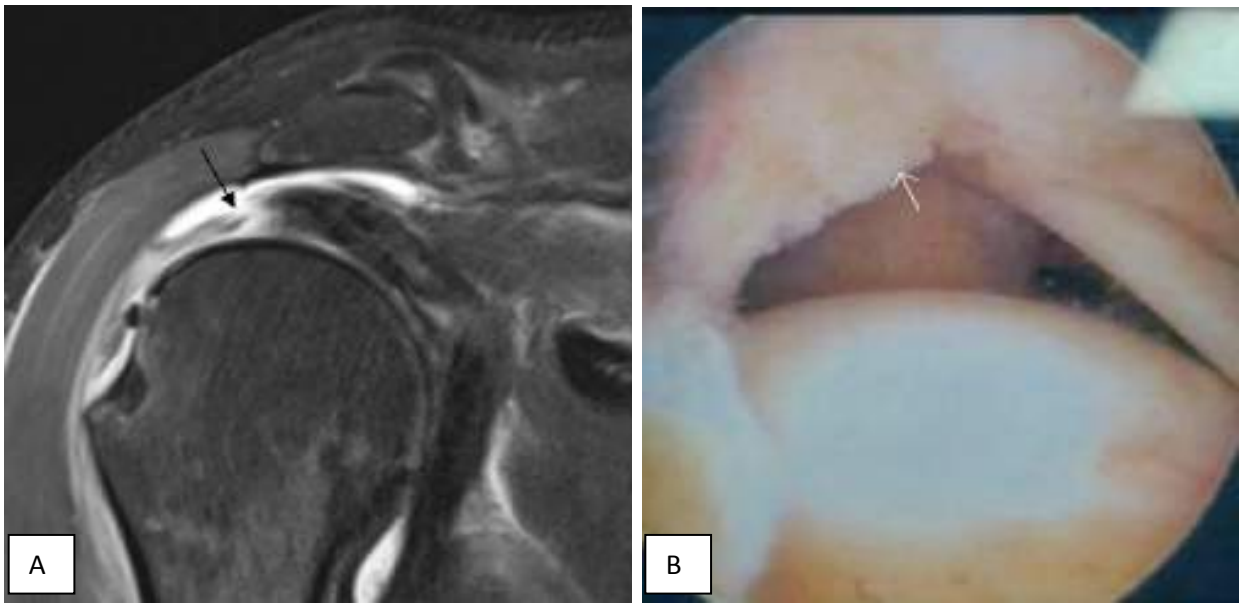
PICTURE 17: A) SAGITTAL T, B)SAGITTAL CT IMAGES SHOWING BONY LOSS ALONG ANTERO-INFERIOR GLENOID RIM IN CASE OF BONY BANKARTS



PICTURE 18: A) AXIAL PD FAT SAT IMAGES SHOWING BONY BANKARTS TEAR, B) CORRESPONDING ARTHROSCOPIC IMAGES SHOWING BONY BANKART.



PICTURE 19: A: CORONAL PD FAT SAT IMAGE SHOWING SLAP TEAR, b) CORRESPONDING ATHROSCOPIC IMAGE SHOWING SLAP TEAR



PICTURE 20: A) CORONAL PD FAT SAT IMAGE SHOWING FULL THICKNESS SUPRASPINATUS TEAR, B)CORRESPONDING ARTHROSCOPIC IMAGE SHOWING FULL THICKNESS SUPRASPINATUS TEAR

Serial no.	Surgery	Patient name	Age	Sex	MRD No.	Acromio clavicular joint degeneration	Acromion type				Spur	Lateral downsloping	Rotator cuf	
							1	2	3	4			Supraspinatous	Infraspinatous
1		RT	61	female	874727	present		present			present	absent		
2	**operated**	SK	29	male	876065	**none**		present			absent	present		
3		AK	35	female	876504	present		present			present	absent	present	
4		SS	46	male	881308	present		present			absent	absent		
5		SPS	48	female	4121	present		present			present	present	present	
6		S	30	male	885048	present		present			absent	present	present	
7		MS	30	male	886254	present		present			absent	absent	present	
8		DK	46	female	887543	present			present		absent	present	present	
9		VK	72	male	675652	present		present			present	present	present	present
10		GK	55	female	888523	present		present			absent	present		
11		S	69	female	631874	present	present				absent	absent	present	present
12		AK	36	female	886000	present	present				absent	present	present	
13	**operated**	AS	61	male	906980	present	present				absent	absent	present	
14		LM	40	female	1164563	present		present			absent	absent	present	
15	**operated**	SS	41	male	1161658	present		present			absent	absent	present	
16		HK	55	female	337315	present		present			present	absent		
17		SA	33	female	910762	present	present				absent	present	present (calcific tendinosis)	
18		SK	65	female	911889	present			present		present	present	present	present
19		DS	17	male	1123479	present		present			absent	present	present	
20		SK	69	male	234876	present		present			present	absent	present	
21		GS	44	male	916367	present		present			absent	present		
22	**operated**	JK	45	female	1124483	present		present			present	present	present	
23	operated	GS	48	male	908640	present		present			present	absent		
24		JS	24	male	1177797	present		present			absent	absent		
25		JR	71	female	934300	present		present			present	absent		
26		KK	57	female	931388	present		present			present	absent		
27		RM	46	male	940261	present		present			present	absent		
28		GSD	62	male	275461	present		present			absent	present	present	present
29	**operated**	FS	24	male	959744	present				present	present		present	
30		AG	25	female	962106	present		present			absent	present		
31		AN	53	male	37607	present		present			absent			
32		MS	61	male	877464	present		present			absent			
33		BMS	69	male	259167	present		present			absent	present	present	
34		BLM	69	male	259167	present		present			present	present	present	

Serial no.	Surgery	Patient name	f tendinosis			Rotator cuff tear								
						supraspinatus					Infraspinatus			
						partial			full thickness		partial			full th
			Teres minor	Subscapularis	Biceps	articular surface	intrasubstance	bursal surface	complete	incomplete	articular surface	intrasubstance	bursal surface	complete
1		RT							present					present
2	**operated**	SK												
3		AK												
4		SS			present									
5		SPS		present										
6		S			present									
7		MS		present										
8		DK												
9		VK			present			present						
10		GK							present					present
11		S												
12		AK												
13	**operated**	AS		present						present				
14		LM								present				
15	**operated**	SS												
16		HK		present		present								
17		SA												
18		SK		present					present					
19		DS												
20		SK							present					
21		GS								present				
22	**operated**	JK							present					present
23	operated	GS		present										
24		JS												
25		JR							present					
26		KK	present	present					present					present
27		RM												
28		GSD	present	present	present	present								
29	**operated**	FS		present										
30		AG												
31		AN												
32		MS							present					present
33		BMS		present										
34		BLM												

Serial no.	Surgery	Patient name		Teres minor		subscapularis		Labrum variant	Labral Degeneration						
			ickness incomplete	partial	full thickness	partial	full thickness		Superior	Inferior	Anterior	Posterior	antero superior	antero inferior	postero superior
1		RT													
2	**operated**	SK									present				
3		AK													
4		SS						sublabral foramen							
5		SPS				present									
6		S													present
7		MS											present	present	
8		DK						sublabral foramina	present						
9		VK													
10		GK													
11		S													
12		AK				present			present		present				
13	**operated**	AS													
14		LM	present									present			
15	**operated**	SS						sublabral recess					present	present	
16		HK													
17		SA													
18		SK				present									
19		DS												present	
20		SK	present												
21		GS	present			present			present						
22	**operated**	JK				present									
23	operated	GS				present									present
24		JS													
25		JR	present				present							present	
26		KK													
27		RM													present
28		GSD									present				
29	**operated**	FS												present	
30		AG						bufords complex			present				
31		AN						sublabral foramen							
32		MS				present		sublabral foramen	present						
33		BMS				present									
34		BLM						sublabral foramen				present			

Serial no.	Surgery	Patient name	Labral Tear								Paralabral cyst	Bony injury in labral tear		
			postero inferior	superior labral antero posterior	bankart	reverve bankart	soft bankart	bony bankart	reverse soft bankart	reverse bony bankart		Hill Sachs	Periosteal stripping	Percentage of bony loss
1		RT												
2	**operated**	SK		present							present	absent		
3		AK												
4		SS												
5		SPS												
6		S	present								none	none		
7		MS			present			present			none	present	present	5%
8		DK												
9		VK												
10		GK												
11		S												
12		AK												
13	**operated**	AS												
14		LM												
15	**operated**	SS			present		present					present		
16		HK												
17		SA												
18		SK												
19		DS			present		present					present	present	5-10%
20		SK												
21		GS												
22	**operated**	JK												
23	operated	GS	present			present			present				present	10%
24		JS											present	10%
25		JR			present		present				absent	present	present	10-15 %
26		KK												
27		RM	present			present				present	absent	reverse	present	25%
28		GSD		present							present	no		
29	**operated**	FS			present		present					present	present	20-25%
30		AG												
31		AN												
32		MS												
33		BMS		present										
34		BLM												

Serial no.	Surgery	Patient name	Age	Sex	MRD No.	Acromio clavicular joint degeneration	Acromion type				Spur	Lateral downsloping	Rotator cuf	
							1	2	3	4			Supraspinatous	Infraspinatous
35		PK	40	male	1003392	present		present			absent		present	
36		JS	53	male	4247	present		present			absent			
37		SG	63	female	753702	present		present		present	absent		present	
38		RM	56	male	860245	present		present			present		present	
39	**operated**	A	29	male	859773	present				present	absent			
40		AG	62	male	277743	present		present			absent			
41	**operated**	IS	32	male	866146	present		present			absent	present	present	
42		AB	17	male	862343	**none**		present			absent		present	
43		JK	68	female	409543	present		present			present			present
44		AS	36	male	857758	present		present			present	present		
45		KK	54	male	869560	present		present			absent			
46		JS	23	male	874142	present		present			absent			present
47		RS	40	male	840661	present		present			present		present	present
48		RS	60	male	832681	present		present			present	present	present	
49		BS	52	male	838679	present		present			absent			
50		RN	18	male	849822	**none**		present			absent		present	
51		AK	62	female	220662	present		present			present	present	present	present
52		GS	60	male	851446	present		present			absent	present	present	
53		GK	39	female	852152	present	present				absent	present	present	
54		NR	59	female	850918	present		present			absent		present	
55		GK	70	female	1020705	present		present			absent	absent		
56		K	66	male	1018130	present		present			present		present	present
57		S	20	male	1001657	**none**		present			absent		present	
58		B	44	female	1030583	present		present			present	present	present	present
59		B	19	male	1043072	present	present				absent			
60		HS	50	male	1013396	present					absent		present	
61		SG	65	female	597935	present		present			absent	present	present	
62		VS	31	male	1052445	present		present			absent			
63		AN	65	male	1070828	present		present			absent	absent		
64		RK	77	female	1081595	present		present			absent		present	
65		RA	69	female	334544	present	present				absent	present		present
66		S	18	male	1132589	present		present			absent	present	present	
67		SK	35	female	7680	**none**	present				absent		present	
68		RJ	35	male	1076373	present		present			absent		present	
69		RK	55	male	1161697	present		present			absent		present	
70		R	23	male	120439	present		present			absent		present	

Serial no.	Surgery	Patient name	f tendinosis			Rotator cuff tear								
						supraspinatus					Infraspinatus			
						partial			full thickness		partial			full th
			Teres minor	Subscapularis	Biceps	articular surface	intrasubstance	bursal surface	complete	incomplete	articular surface	intrasubstance	bursal surface	complete
35		PK												
36		JS		present										
37		SG		present	present	present								
38		RM						present						
39	operated	A												
40		AG		present					present		present			
41	operated	IS												
42		AB												
43		JK		present	present						present			
44		AS				present								
45		KK												
46		JS									present			
47		RS		present		present		present						
48		RS		present		present								
49		BS							present					present
50		RN												
51		AK		present						present	present			
52		GS		present		present								
53		GK		present										
54		NR				present								
55		GK							present					present
56		K				present								
57		S												
58		B					present							
59		B												
60		HS				present	present							
61		SG		present										
62		VS												
63		AN							present					
64		RK							present					present
65		RA			present				present			present		
66		S												
67		SK			present									
68		RJ												
69		RK												
70		R												

Serial no.	Surgery	Patient name		Teres minor		subscapularis		Labrum variant	Labral Degeneration						
			ickness incomplete	partial	full thickness	partial	full thickness		Superior	Inferior	Anterior	Posterior	antero superior	antero inferior	postero superior
35		PK											present	present	
36		JS													
37		SG													
38		RM													
39	operated	A						recess						present	
40		AG	present												
41	operated	IS							present				present	present	
42		AB													
43		JK				present									
44		AS						sublabral recess							
45		KK											present		
46		JS							present		present				
47		RS							present		present				
48		RS							present						
49		BS							present		present				
50		RN											present	present	
51		AK				present		sublabral foramen							
52		GS							present						
53		GK							present						
54		NR				present		sublabral foramen							
55		GK				present									
56		K										present	present		
57		S						sublabral recess					present	present	
58		B						sublabral recess					present	present	
59		B							present						
60		HS													
61		SG							present				present	present	
62		VS				present									
63		AN	present			present		sublabral recess					present		
64		RK													
65		RA				present									present
66		S													
67		SK													present
68		RJ													present
69		RK							present				present	present	
70		R													

Serial no.	Surgery	Patient name	Labral Tear								Paralabral cyst	Bony injury in labral tear		
			postero inferior	superior labral antero posterior	bankart	reverve bankart	soft bankart	bony bankart	reverse soft bankart	reverse bony bankart		Hill Sachs	Periosteal stripping	Percentage of bony loss
35		PK												
36		JS		present							absent	no		
37		SG												
38		RM												
39	**operated**	A			present			present				present	present	20-25%
40		AG												
41	**operated**	IS			present		present					present	present	35-30%
42		AB												
43		JK												
44		AS		present										
45		KK												
46		JS												
47		RS												
48		RS												
49		BS												
50		RN			present		present						present	<25%
51		AK												
52		GS												
53		GK												
54		NR												
55		GK												
56		K	present			present			present					
57		S			present		present							
58		B			present			present						
59		B		present								present	present	20-25%
60		HS												
61		SG			present			present						
62		VS										present	present	15-20%
63		AN												
64		RK												
65		RA	present											
66		S												
67		SK												
68		RJ	present											
69		RK			present			present						
70		R										present	present	18.2%

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No. BFUHS/2K21p-TH/ 545

Date 24/2/2021

The Principal,
DMC,Ludhiana.

Subject: **Approval of Plan of Thesis.**

This is to inform you that the Faculty of Medical Sciences in its meeting held on 22.01.2021 has approved the plan of thesis of **Dr. Arpit Jindal**, a student of your college for **MD Radio-Diagnosis** along with the names of Supervisor/Co-Supervisor as under:-

Topic Plan of Thesis
Spectrum of mri findings in rotator cuff pathologies and glenohumeral instability

Supervisor
Dr. Kamini Gupta
Prof.,
Dept. of Radio-Diagnosis,
DMCH, Ludhiana.

Co-Supervisor
Dr. Rajnish Garg
Prof. & Head,
Dept. of Orthopaedics,
DMCH, Ludhiana.

The student has to submit the three copies of thesis (along with PDF format) , to the Controller of Examinations, BFUHS, Faridkot, at least six months before the commencement of theory examination, if he/she is otherwise eligible to take the examination. He /She must directed to attach a photocopy of this letter with the forwarding letter while submitting thesis to the University along with the letter of approval of University for change of supervisor/Co-Supervisor, change of topic,(if any).

Dr. S P Singh MS(Oph)
Controller of Examinations

Note :

1. ***If any discrepancy found regarding topic of thesis or Supervisor/Co-Supervisor, inform undersigned within one month after issue of this letter.***
2. *The student may submit the thesis as per the schedule already conveyed i.e for May/June examination 30th Nov of the preceding the year of examination and for Nov/Dec examinations 31st May of the year of examination.*

SPECTRUM OF MRI FINDINGS IN ROTATOR CUFF PATHOLOGIES AND GLENOHUMERAL INSTABILITY

THESIS PROPOSAL

FOR APPROVAL OF SUBJECT OF THESIS TO BE SUBMITTED IN

PARTIAL FULFILMENT OF THE REQUIREMENTS

FOR THE DEGREE OF

MD

In

Department of Radiodiagnosis

OF THE

BABA FARID UNIVERSITY OF HEALTH SCIENCES

FARIDKOT

November, 2019

Dr. Arpit Jindal

DEPARTMENT OF RADIODIAGNOSIS
DAYANAND MEDICAL COLLEGE AND HOSPITAL
LUDHIANA

ABSTRACT OF PLAN OF THESIS

Title	SPECTRUM OF MRI FINDINGS IN ROTATOR CUFF PATHOLOGIES AND GLENOHUMERAL INSTABILITY
For the degree of	M.D. Radiodiagnosis
Name of the candidate	Dr. Arpit Jindal
Supervisor	Dr. Kamini Gupta, Professor, Department of Radiodiagnosis, DMCH, Ludhiana
Co-supervisor	Dr. Rajnish Garg, Professor & Head, Department of Orthopaedics, DMCH, Ludhiana
Institution	Dayanand Medical College & Hospital, Ludhiana
University	Baba Farid University of Health Sciences, Faridkot

Introduction: Shoulder pain can be due to a variety of causes. Acute fractures can be evaluated using routine radiographs but patients with protracted pain and atypical presentations like in rotator cuff pathologies and glenohumeral instability, need better mode of evaluation. MRI (preferably 3 tesla) is valuable in diagnosing rotator cuff tendinosis, tears and glenohumeral instability. Even though MR Arthroscopy is gold standard in diagnosing shoulder joint disorders, recent studies have shown the accuracy of MRI comparable to that of MR Arthroscopy with the advantage of being completely non-invasive and free from radiation.

Aim of study: 1) To study the spectrum of MRI findings in Rotator cuff pathologies and glenohumeral instability.2)To correlate MRI findings with arthroscopic findings wherever possible.

Materials and Methods: A prospective study of clinically suspected patients of rotator cuff pathologies and glenohumeral instability referred to the department of Radiodiagnosis, DMCH for MRI shoulder joint from 1st december 2019 to 1st may 2021.

INCLUSION CRITERIA:

- Patients who are clinically suspected to have rotator cuff pathology.
- Patients with shoulder joint dislocations.
- Patients with pain and restricted shoulder movement and diagnosed on MR imaging as having glenohumeral instability and rotator cuff pathologies.

EXCLUSION CRITERIA:

- Patients who have undergone prior shoulder surgeries
- Any contraindication to MRI as per checklist on departmental MRI form.
- Anyone not willing to participate in study

Clinical Significance:

The main advantage of 3.0T MRI is its ability to precisely localize and characterize the pathology in all three planes. The detailed pre operative non-invasive evaluation of rotator cuff and labral pathologies are important for clinician to decide the mode of management.

Keywords: 3.0T MRI, Rotator cuff tear, Glenohumeral instability, arthroscopy

(Signature)	(Signature)	(Signature)	(Signature)
Candidate	Co-Supervisor	Supervisor	Principal

CERTIFICATE OF FACILITIES AVAILABLE

This is to certify that the facilities for work on the subject of thesis titled **"SPECTRUM OF MRI FINDINGS IN ROTATOR CUFF PATHOLOGIES AND GLENOHUMERAL INSTABILITIES"** exist in the Department of Radiodiagnosis, DMC&H, Ludhiana and will be provided to the candidate. We will see that the data being included in the thesis is genuine and is collected by the candidate himself under our supervision and guidance.

Supervisor

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Co-Supervisor

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Dr. Kavita Saggar
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Place : _____

Date : _____

APPROVAL PROFORMA
BY
RESEARCH & ETHICAL COMMITTEE
DAYANAND MEDICAL COLLEGE & HOSPITAL, LUDHIANA

Name of candidate	Dr. Arpit Jindal
Department	Radiodiagnosis
Topic of Thesis	SPECTRUM OF MRI FINDINGS IN ROTATOR CUFF PATHOLOGIES AND GLENOHUMERAL INSTABILITIES
Likely date of appearing in PG examination	May2022
Date of enrollment	1st MAY, 2019
Name of Head of Department	Dr. Kavita Saggar
1) Supervisor **2) Co-Supervisor(s)**	Dr. Kamini Gupta Dr. Rajnish Garg
Signature of Members of Research Committee with Stamp	**Signature of Members of Ethics Committee with Stamp**
Dr. Jaspal Singh (Professor & Head, Surgery)	Mr. A K Jindal (Member, Ethics Committee)
Dr. Dinesh Gupta (Professor & Head, Medicine)	Dr. Anu Sharma (Professor, Anatomy)
Dr. Sandeep Kaushal (Assistant Dean Academics)	Dr. Deepinder K Chhina (Professor & Head, Microbiology)
Dr. Rajoo Singh Chhina (Dean Academics)	Dr. Neena Sood (Professor & Head, Pathology)
Dr. Gurpreet S Wander (Vice Principal)	Dr. Gurpreet S Wander (Vice Principal)
	Dr. Gagandeep Singh (Secretary, Ethics Committee Professor & Head, Neurology)

Approved: Yes / ~~No~~

Dr. Sandeep Puri
Chairperson
Research Committee

Chairperson
Research Committee

Approved: Yes / ~~No~~

Prof. Arvind Malhotra
Chairperson
Ethics Committee

Chairperson

BABA FARID UNIVERSITY OF HEALTH SCIENCES, FARIDKOT

PROFORMA FOR REGISTRATION OF SUBJECT FOR DISSERTATION

1	NAME OF THE CANDIDATE AND ADDRESS	ARPIT JINDAL House No. 2 , Bharat Nagar ,Bibi Wala Road , Bathinda
2	NAME OF THE INSTITUTE	DAYANAND MEDICAL COLLEGE AND HOSPITAL , LUDHIANA
3	COURSE OF STUDY AND SUBJECT	M.D. RADIODIAGNOSIS
4	DATE OF ADMISSION OF COURSE	1 MAY, 2019
5	TITLE OF THE TOPIC	SPECTRUM OF MRI FINDINGS IN ROTATOR CUFF PATHOLOGIES AND GLENOHUMERAL INSTABILITY

6. BRIEF RESUME OF THE INTENDED WORK

6.1 NEED FOR THE STUDY

Shoulder pain can cause significant discomfort and reduce the ability to perform activities of daily living. Thus, with an estimated prevalence of 16-26%, it is third most common cause of musculoskeletal consultation.[1] Shoulder pathologies include a spectrum of intraarticular and extraarticular disturbances like rotator cuff tears, labral injuries, adhesive capsulitis, impingement syndrome and instability.

Multiple imaging modalities are currently used to evaluate pathologic conditions of the shoulder like conventional radiography, fluoroscopy, sonography, nuclear medicine and MRI (Magnectic Resonance Imaging).[2]

Evaluation of rotator cuff pathologies is a routine task for radiologists. [3-5] MR Arthrography is considered as the gold standard investigation for shoulder pathologies, however it is invasive, expensive and even not available readily at many centers and hence it is reserved for athletes and in complicated cases.[4,5] The flaccidity of the capsule can be difficult to determine due to the process of the arthroscopic examination itself altering the laxity of the joint. The procedure being invasive carries small risks of complications such as infection, damage to adjacent structures (e.g. musculocutaneous nerve or articular cartilage) and fluid extravasation. Complications may also arise from use of anaeshthetic agents.[2]

MR Arthrography has been reported to be more accurate than conventional MRI in the detection of labral tears. However, these reports were based on studies performed in the 1990's using equpment with lower resolution than is availaible today. Now, high sensitivity and specificity for detection of rotator cuff and labral abnormalities has been shown in literature for both MRI and MRarthrography.

Recent studies have shown that routine MRI is gaining grounds compared to MR arthrography with similar sensitivity values reported for detection of cuff tears.[5]

Even though MR arthrography is advantageous for detection of small articular surface tears but some authors report that these lesions do not modify the management of most of these patients.[6-8] Values of sensitivity on 1.5 T MRI

ranges from 80 to 100% for complete tears and between 35-87% for partial tears and specificity values between 83 and 98%. and 85% and 97% respectively.[9-12] Whereas on 3T MRI sensitivity and specificity were 98% and 96% for complete tears and 92% and 100% for partial tears [10] and a positive predictive values for detecting complete surgical tears was 100% for complete and 92% for partial thickness tears.[13] High field MRI thus reduce the number of false negative results and increase the value of conventional MR over MR arthrography.

Glenohumeral joint is the most commonly dislocated joint in the body with anterior instability being much more common than posterior.[14] Glenohumeral dislocation is a has a reported prevalence of about 2% and anterior instability being the most common.[15] It is defined as the dissociation between the glenoid and the humeral head.[16] Despite reduction and immobilization following the first dislocation, a patient can present with recurrent instability with a resultant decrease in the functionality of the shoulder, thus restricting occupational and athletic activities alike.[17]

The most common lesion associated with a traumatic anterior dislocation of the shoulder is a tear of the anteroinferior labrum known as the "Bankart lesion" or its variations, which are being increasingly recognized.[16] The Bankart "essential lesion" is an avulsion of the labrum from the anterior inferior glenoid with an associated tear in the labrum.[18] Its corresponding lesion in the humeral head, namely the Hill–Sachs lesion, is frequently associated with the Bankart lesion, and its extent modifies the type of intervention routinely performed for the management of isolated Bankart lesions.

Glenohumeral joint instability is usually an intimidating topic for most radiologists due to both the complexity of related anatomical and biochemical considerations and increasing number of classifications.

MRI is a very sensitive and specific tool in the detection of lesions commonly associated with shoulder instability, namely Bankart and Hill–Sachs lesions. MRI is noninvasive, which combines the soft-tissue contrast with tomographic possibilities, without using ionizing radiation. It is also useful in demonstrating both, the superficial and deep structures, and can differentiate bone, cartilage, and ligaments with precision. It provides the orthopedic surgeon a view to the

possible hurdles he/she might face during surgery, by also showing lesions which are not commonly thought to accompany shoulder instability. It assists in classification and preoperative assessment of the pathology.[19]

The role of radiologist in assessing glenohumeral instability lesions is to properly describe the stabilizing structures involved to localize them and attempt to characterize them as acute or chronic. With the advent of new technology and better equipment, newer imaging sequences, and improved technical know-how, the non-invasive preoperative detection of lesions predictive of recurrent shoulder instability along with associated shoulder disorders has improved dramatically, as shown by Kirkley et al [20] and planning the surgery preoperatively. In patients whom a diagnosis is doubtful, MRI has a definite role in the diagnosis and possible prevention of an unneeded surgical intervention[19]

6.2 REVIEW OF LITERATURE

V.P Chandani et al (1993) prospectively compared MR imaging, MR arthrography and CT arthrography in 30 patients 19-39 years old who had either signs and symptoms of shoulder instability or shoulder pain of unexplained origin to determine the sensitivity of each technique in detecting glenoid labrum tears and in determining whether the labrum is detatched or degenerated. They concluded that MR arthrography and MR imaging both showed labral tears with greater sensitivity than CT arthrography did. MR imaging and MR arthrography also enabled direct visualization of rotator cuff disease and other unsuspected anomalies.[21]

Davidson JF et al(2005) evaluated MRI scans of Sixty-six preoperative. The maximum medial to lateral length (L) of the tear was measured on T2-weighted coronal cuts. The maximum anterior to posterior width (W) was measured on T2-weighted sagittal cuts. The cases were divided into 3 groups: group 1, short-wide tears, L < or = W, L < 2 cm; group 2, long-narrow tears, L > W, W < 2 cm; and group 3, long-wide tears, L > or = 2 cm, W > or = 2 cm.

And concluded that Tear pattern and method of repair can be predicted on high-quality MRI scan. Group 1, L < or = W and L < 2 cm, predicts a crescent-shaped tear and end-to-bone repair (positive predictive value, 93.8%). Group 2, L > W and W < 2 cm, predicts a longitudinal tear and side-to-side/margin convergence repair (positive predictive value 100%). Group 3, L > or = 2 cm and W > or = 2 cm, predicts a massive contracted tear and that primary end-to-bone or side-to-side repairs are usually not possible and that interval slides or partial repair may be necessary (positive predictive value, 76.5%). The overall diagnostic model based on usable MRI scans significantly predicted arthroscopic findings.[22]

Thomas H Magee et al (2006) performed MRI examination on 100 patients between October and december 2014. All 100 patients presented with shoulder pain, instability or both and concluded that 3.0 T MRI of shoulder joint is very sensitive and specific compared with arthroscopy in detection of superior, anterior, and posterior labral tears.[23]

Magee T et al (2006) evaluated 150 patients who subsequently went arthroscopy. The radiologists interpreted the MR images by consensus without knowledge of the arthroscopy results. Scans were interpreted for full-

thickness or partial-thickness supraspinatus tendon tears. If partial-thickness supraspinatus tendon tears were seen on MRI, the reviewers noted whether the partial-thickness tear was articular or bursal in location. The radiologists also separated the supraspinatus tendon tears into small (< 1 cm retraction from the humeral head) and large (> 1 cm retraction from the humeral head) and concluded that 3.0T MRI is highly sensitive and specific compared with arthroscopy in the detection of full thickness and partial thickness supraspinatus tear [10]

Kirkley, Alexandra MD et al(2006) studied Sixteen patients, aged 18 to 30 years, for Correlation between arthroscopy and magnetic resonance imaging and concluded that Magnetic resonance imaging can be considered a valuable tool for the detection of Hill-Sachs and Bankart lesions associated with primary traumatic anterior dislocations of the shoulder. Its ability to detect other pathologic lesions, however, is limited.[20]

A Lambert et al (2009) correlated surgical and imaging findings for 48 patients who underwent surgery for rotator cuff tear and concluded that 3.0T MRI is valuable for detection of small tears, especially for partial thickness tears due to increased spatial resolution and the surgical candidates and surgical planning are improved due to more accurate measurements of tear size and quality if the tendon edges.[13]

Meredith L. Hayes et al (2010) studied 87 consecutive patients who underwent diagnostic MRI and shoulder arthroscopy for instability from 1997 to 2006. MR images were reviewed by two radiologists and interpreted by consensus for the presence of articular cartilage lesions (including Hill–Sachs and Bankart lesions), which were then confirmed by reviewing the operative report and images recorded at arthroscopy and concluded that Magnetic resonance imaging demonstrates high sensitivity and specificity for the diagnosis of articular cartilage injuries in patients with glenohumeral instability.[24]

Utkarsha Pradeep Joshi et al (2014) did A prospective study of 30 patients of shoulder instability, The patients were first examined clinically, followed by 1.5 tesla MRI scan and finally arthroscopically. The findings of diagnostic arthroscopy were correlated with clinical & MRI findings. By obtaining correlation between clinical examination, MRI scan and arthroscopy for

anterior and posterior shoulder instability, concluded that MRI can give a better diagnosis of the pathology in comparison to clinical examination.[25]

Omid R Momenzadeh et al (2015) evaluated 80 patients with shoulder joint disorders who underwent arthroscopy and concluded that the MRI can be a useful tool in ruling out possible abnormalities in the shoulder and to give clues to the most probable diagnosis.[26]

Nevin et al (2016) compared 60 patients complaining of shouldr pain. Conventional MRI and MR arthrography were done for all cases. The musculoskeleral radiologists reviewed the images for evidence of labroligamentous complex and concluded that however MRI cannot replace MR Arthrography but the could be a potent tool for diagnosis of the main pathological affection of the shoulder joint guided by the type of population , which proved to have good impact on diagnosis.[27]

Abhinav Bhatnagar et al(2016) evaluated 39 patients of chronic shoulder pain and restricted shoulder movements and concluded that rotator cuff pathologies is the most common pathology and that MRI is effective in diagnosing rotator cuff tears, Bankart's tear and osteochondral defects but was not found to be helpful in diagnosing SLAP lesions. MRI and arthroscopy have complimentary roles in the diagnosis of shoulder pathology.[28]

Gururaj Sharma et al (2017) evaluated A total of 82 patients were diagnosed with rotator cuff injury on MRI during this period, out of which 45 patients who underwent further evaluation with arthroscopy and concluded that MRI revealed high sensitivity and specificity for the diagnosis of rotator cuff tears and MRI provides useful information about the size and extent of the tear, involvement of adjacent structures, presence of muscle atrophy and tendon retraction, all of which have important therapeutic and prognostic implications.[29]

Yogesh Sharma et al (2019) did a diagnostic evaluation study, estimating the accuracy of MRI in diagnosing lesions encountered in shoulder dislocations vis-a-vis shoulder arthroscopy. Ninety participants of anterior shoulder dislocation were evaluated preoperatively with a shoulder MRI. The study participants were later subjected to a diagnostic shoulder arthroscopy and managed operatively and concluded that MRI is a very sensitive and specific

tool in the detection of lesions commonly associated with shoulder instability, namely Bankart and Hill–Sachs lesions.[19]

6.3 AIMS AND OBJECTIVES OF THE STUDY

1) To study the spectrum of MRI changes in Rotator cuff pathologies and glenohumeral instability.

2) To correlate with arthroscopic findings wherever possible.

7. MATERIALS AND METHODS

7.1 Source of Data

A prospective study of clinically suspected patients of rotator cuff pathologies and glenohumeral instability undergoing MRI of shoulder joint in the department of Radiodiagnosis, Dayanand Medical College and Hospital, from December 1 , 2019, to May 1 , 2021.

7.2 METHOD OF COLLECTION OF DATA

Patients suspected clinically to have rotator cuff pathologies/ glenohumeral instability and referred to the department will be included in study. Consent will be obtained from each patient and relevant detailed history will be elicited from all patients. Before starting MRI study, the procedure will be explained to the patients in his/her vernacular language to allay anxiety and fear. Written informed consent will be taken.

INCLUSION CRITERIA:

- Patients who are clinically suspected to have rotator cuff pathology.
- Patients with shoulder dislocations
- Patients with pain and restricted shoulder movement and diagnosed on MRI imaging as having glenohumeral instability or rotator cuff pathologies.

EXCLUSION CRITERIA:

- Patients who have undergone prior shoulder surgeries
- Any contraindication to MRI as per checklist on departmental MRI form.
- Anyone not willing to participate in study

MR IMAGING TECHNIQUE

All patients will undergo a multiplanar, multi sequential MRI scan of shoulder joint on a MAGNETON SKYRA 48 Channel 3 Tesla MR Scanner by Siemens, Germany,

Sequences	PD FS axial	T1 axial	PD FS Coronal	T2FS coronal	T2 coronal	PD FS saggital	T1 saggital
Acquisition time	2:53	1:58	3:15	2:37	2:26	2:30	1:45
Orientation	Axial	Axial	Coronal	Coronal	Coronal	Saggital	Saggital
Number of slices	256x320	269x384	269x384	256x384	269x320	256x320	269x384
No. of slices	25	25	21	21	21	23	23
FoV read(mm)	140	140	150	160	140	140	140
FoVPhase(%))	100	100	100	100	100	100	100
Slice thickness(mm	3	3	3	3	3	3	3
Slice gap(mm)	1.7	1.7	0.5	0.5	0.5	0.7	0.7
Repetition time(msec)	3000	538	3800	3800	3800	4000	478
Echo time(msec)	32	11	35	73	78	34	11
Flip angle (deg)	150	150	150	150	150	150	150
Fat suppression	Yes	No	Yes	Yes	No	Yes	No
Flow compression	Read	No	Read	Read	No	Read	No
Phase enc. Dir.	A>>P	A>>P	A>>P	A>>P	A>>P	F>>H	H>>F

OUTCOME

- The study will focus on non-invasive detailed evaluation of rotator cuff pathologies and glenohumeral instabilities so as to optimize management of patients.

STATISTICAL ANALYSIS:

Data will be described in terms of range; mean ±standard deviation (± SD), frequencies (number of cases) and relative frequencies (percentages) as appropriate. All statistical calculations will be done using SPSS (Statistical Package for the Social Science) SPSS 21 version statistical program for Microsoft Windows.

7.3 DOES THE STUDY REQUIRE ANY INVESTIGATIONS OR INTERVENTIONS TO BE CONDUCTED ON PATIENTS OR OTHER HUMANS OR ANIMALS? IF SO, PLEASE DESCRIBE BRIEFLY.

No

7.4 HAS ETHICAL CLEARANCE BEEN OBTAINED FROM YOUR INSTITUTION IN CASE OF 7.3?

Attached herewith

8. LIST OF REFERENCES

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PROFORMA

PATIENT DETAILS:

NAME: MRD NO.

AGE: SEX:

ADDRESS:

CLINICAL HISTORY:

PAIN:

RESTRICTION OF MOVEMENT:

FEVER:

EXTERNAL SWELLING:

PRIOR HISTORY OF INJURY:

PREVIOUS DISLOCATION:

PRIOR SHOULDER SURGERY:

RADIOLOGICAL INVESTIGATIONS:

XRAY (IF DONE)

Signature of Candidate **Signature of Supervisor**

MRI DETAILS:

LABRUM	
VARIANT	
TEAR	
LOCATION	
EXTENT	
PARAMENISCAL CYST	
DISPLACED FRAGMENT	

IN CASE OF BANKART'S	
HILL SACHS	
EXTENT OF TEAR	
CONDITION OF LABRUM/ POSITION OF LABRUM	
PERIOSTEAL STRIPPING	
CARTILAGE DAMAGE	
BONY BANKARTS	
PERCENTAGE OF BONY LOSS	
CAPSULITIS	
HUMERAL/ GLENOID ATTATCHMENT OF IGHL	

SUBACROMIAL SPACE	
TYPE OF ACROMIAN	
CORACOACROMIAL LIGAMENT	
SPUR ALONG THE INFERIOR ASEPECT OF ACROMIAN	
ANGULATION OF ACROMIAN	
OS ACROMIALE	
DEGENERATIVE CHANGES AT ACROMIOCLAVICULAR JOINT	
BURSITIS	

Signature of Candidate **Signature of Supervisor**

ROTATOR CUFF TENDONS		
	SUPRASPINATUS	**INFRAPINATUS**
FRAYING		
TENDINOSIS		
DELAMINATION		
TEAR		

PARTIAL TEAR

ARTICULAR/BURSAL/INTRASUBSTANCE	
LOCATION	
EXTENT	
SIZE OF TEAR	
CONDITION OF REST OF THE TENDON	

FULL THICKNESS TEAR

INCOMPLETE	
COMPLETE	

SUBSCAPULARIS TENDON	
BICEPS TENDON	
TENDINOSIS	
PARTIAL TEAR	
SUBLUXATION	
DISLOCATION	
PULLEY LESION	
PARALABERAL CYSTS	
GLENOHUMERAL CARTILAGE	
ROTATOR INTERVAL	
BONE AND REST OF THE SOFT TISSUE	
BURSA/RECESSES	

Signature of Candidate **Signature of Supervisor**

CT SCAN (IF AVAILAIBLE)

FINAL MRI IMPRESSION

ARTHROSCOPIC FINDINGS AND CORRELATION

Signature of Candidate

Signature of Supervisor

INFORMED PATIENT CONSENT

Date: _____

I.....D/o, W/o, S/o..... .....am willing to participate in the study **"SPECTRUM OF MRI FINDINGS IN ROTATOR CUFF PATHOLOGIES AND GLENOHUMERAL INSTABILITIES"** The procedure with its complications has been explained to me in local vernacular language. I have fully understood that no special tests and extra expenditure in any form, merely for the purpose of thesis is being carried out. I am free to opt out the study any time without assigning any reason.

....

Signature of the Witness Signature of the patient

Name:

Signature of Candidate **Signature of Supervisor**

मरीज अनुमति फार्म

तिथि _____

मैं _____ पत्नी/पुत्र/पुत्री _____

निवासी _____

इस शोधकार्य **"SPECTRUM OF MRI FINDINGS IN ROTATOR CUFF PATHOLOGIES AND GLENOHUMERAL INSTABILITIES"** में भाग लेने के लिए सहमत हूँ। मैं इस शोधकार्य में भाग लेने के लिए अपनी स्वेच्छा से तैयार हूँ। मैं पुष्टि करता/करती हूँ की यह स्वीकृति देने के लिए मुझे कोई आर्थिक प्रलोभन नहीं दिया गया और न ही दबाव डाला गया है। मुझे इस शोधकार्य का उद्देश्य स्पष्ट कर दिया गया है और मुझे यह विश्वास है की यह विज्ञान और मानवता के लाभ के लिए है। मुझे इस शोधकार्य में होने वाले जोखिम के बारे में समझा दिया गया है और मेरी समझ में यह जोखिम बहुत मामुली है।

मैं इस शोधकार्य में भाग लेने के सम्बन्ध में किसी भी समय अपनी अस्वीकृति व्यक्त कर सकता/सकती हूँ और मेरे अस्वीकृति व्यक्त करने का मेरे इलाज पर कोई प्रभाव नहीं पड़ेगा।

_____ _____

गवाह के हस्ताक्षर रोगी के हस्ताक्षर/अंगूठे का निशान

नाम: नाम:

_____

अन्वेषक के हस्ताक्षर

_____

विद्यार्थी के हस्ताक्षर

ਮਰੀਜ਼ ਰਜ਼ਾਮੰਦੀ ਫਾਰਮ

ਮਿਤੀ_____

ਮੈ_____ਪਤਨੀ/ਪੁੱਤਰ/ਪੁੱਤਰੀ_____

ਵਾਸੀ _____

"SPECTRUM OF MRI FINDINGS IN ROTATOR CUFF PATHOLOGIES AND GLENOHUMERAL INSTABILITIES" ਤੇ ਚਲ ਰਹੀ ਖੋਜ ਵਿਚ ਹਿੱਸਾ ਲੈਣ ਲਈ ਰਜ਼ਾਮੰਦ ਹਾਂ। ਇਸ ਖੋਜ ਕੰਮ ਵਿਚ ਹਿੱਸਾ ਲੈਣ ਲਈ ਮੈ ਆਪਣੀ ਮਰਜ਼ੀ ਨਾਲ ਤਿਆਰ ਹਾਂ। ਮੈ ਇਹ ਦਸਣਾ ਚਾਹੁੰਦਾ ਹਾਂ/ ਚਾਹੁੰਦੀ ਹਾਂ ਕੇ ਇਹ ਰਜ਼ਾਮੰਦੀ ਦੇਣ ਵਾਸਤੇ ਮੈਨੂ ਕਿਸੇ ਵੀ ਤਰਾਂ ਦਾ ਲੋਭ-ਲਾਲਚ ਨਹੀ ਦਿੱਤਾ ਗਿਆ ਅਤੇ ਨਾ ਹੀ ਕੋਈ ਦਬਾ ਪਾਇਆ ਗਿਆ ਹੈ। ਮੈਨੂ ਇਸ ਖੋਜ ਦਾ ਮਨੋਰਥ ਸਮਝਾ ਦਿੱਤਾ ਗਿਆ ਹੈ ਅਤੇ ਮੈਨੂ ਇਹ ਭਰੋਸਾ ਦਵਾਇਆ ਗਿਆ ਹੈ ਕੇ ਇਹ ਖੋਜ ਵਿਗਿਆਨ ਅਤੇ ਮਾਨਵਤਾ ਦੀ ਭਲਾਈ ਲਈ ਹੈ। ਮੈਨੂ ਇਸ ਖੋਜ ਵਿਚ ਹੋਣ ਵਾਲੇ ਖਤਰੇ ਬਾਰੇ ਸਮਝਾ ਦਿੱਤਾ ਗਿਆ ਹੈ ਅਤੇ ਮੈਨੂ ਇਹ ਯਕੀਨ ਹੈ ਕੇ ਇਹ ਖਤਰਾ ਬਹੁਤ ਮਾਮੂਲੀ ਹੈ। ਮੈਨੂ ਇਸ ਖੋਜ ਕੰਮ ਵਿਚ ਹਿੱਸਾ ਲੈਣ ਦਾ ਢੰਗ – ਤਰੀਕਾ ਸਮਝਾ ਦਿੱਤਾ ਗਿਆ ਹੈ।
ਮੈ ਇਸ ਖੋਜ ਕੰਮ ਵਿਚ ਹਿੱਸਾ ਲੈਣ ਬਾਰੇ ਆਪਣੀ ਰਜ਼ਾਮੰਦੀ ਕਿਸੇ ਵੀ ਸਮੇ ਵਾਪਸ ਲੈ ਸਕਦਾ ਹਾਂ/ ਸਕਦੀ ਹਾਂ ਅਤੇ ਮੇਰੀ ਰਜ਼ਾਮੰਦੀ ਵਾਪਸ ਲੈਣ ਦਾ ਮੇਰੇ ਇਲਾਜ ਤੇ ਕੋਈ ਅਸਰ ਨਹੀ ਹੋਵੇਗਾ।

_____
ਗਵਾਹ ਦੇ ਹਸਤਾਖਰ

ਮਿਤੀ_____

ਪਤਾ _____

_____
ਮਰੀਜ਼ ਦੇ ਹਸਤਾਖਰ

ਮਿਤੀ_____

ਪਤਾ _____

_____
ਨਿਰੀਖਕ ਦੇ ਹਸਤਾਖਰ

_____
ਸਿਖਿਆਰਥੀ ਦੇ ਹਸਤਾਖਰ